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QUARTERLY

OF THE

National Fire Protection Association

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EDITED BY THE SECRETARY

National Fire Protection Association.

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Western Factory Insurance Association.
Western Sprinklered Risk Association.
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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Too Hot a Fire.

Miscellaneous Fire No. H-4647.

Failure of wired glass from too severe exposure by fire within building. Note satisfactory condition of metal frames and that glass alone failed.

President William H. Taft to President William H. Merrill:—"*Much of the loss of life and property by fire in the United States is undoubtedly preventable. The extent and nature of our fire losses manifestly bring the question of the fire waste prominently forward in connection with conservation effort.*"—(Interview, Washington, May 30, 1911.)

The Quarterly

Vol. 5 **July, 1911** **No. 1**

The Annual Meeting. It is some years since such a heavy budget of important committee reports has been disposed of at an annual meeting as that with which the Association grappled this year at the Waldorf-Astoria. The committee on Devices and Materials, with its carefully worked-out test specifications for Roofings; the committee on Fire Hose, with its timely contribution of experience and vital recommendations for the public good; Mr. Newbern's admirable paper on Private Fire Departments and Fire Drills, which is to be the basis for the revision of our pamphlet on that subject; and the most valuable and painstaking reports of the committees on Signaling Systems, Municipal Fire Alarm Systems, Fire Prevention Ordinances and Theatre Construction; all these made up such a volume of matter as to require the full time of the three days' session to dispose of it. The quick and vigorous intellect of President Merrill moved the program steadily along without stage waits,—a vital consideration when such voluminous and important matters are on the carpet.

These committee reports are of absorbing interest to a considerable percentage of our members who habitually attend the meetings, and the discussions during their presentation are educative and helpful, especially to the younger engineers. It was suggested during the New York meeting that rooms like the great ball room of the Waldorf-Astoria are too large for the consideration of committee reports, even when they do not echo the blows of outside carpenters' hammers—as the room did this year owing to the hotel front undergoing repairs—and that we might have different sized rooms for our different functions.

Our distinguished active member the American Institute of Architects not only changes rooms, but during the week of its last annual meeting in California changed cities, even. Its business sessions were in the Fairmont Hotel in San Francisco, and others in the Greek Theatre at Berkeley and in Palo Alto, Monterey, Santa Barbara and Los Angeles.

As there is seldom an attendance of over two hundred during the committee report discussions of the N. F. P. A. meeting, it would be perfectly feasible to have the formal addresses and the opening exercises in a large audience chamber, and the other meetings in a smaller room where the debaters may be heard easily and the strain of the meeting be less than in a large chamber. It is worth thinking about.

* * * * *

Our Reception in New York. Secretary Charles E. Meek, in the informal remarks prefacing his admirable address "The Fire Nation," pointed out the fact that New York, city or state, had taken no official notice of our meeting, and had no mayors or governors on hand to make speeches of welcome. As such speeches are invariably perfunctory, and as we always have a good many things to say ourselves, we have never encouraged our local members to arrange for such official courtesies.

The attention of the New York press was all we could desire and no public function could have approached in character and social usefulness the beautiful banquet tendered us by our associate member the Insurance Society of New York. Such generous hospitality is seldom encountered by such large bodies of delegates as our own, and the Association by formal resolution and by the speeches of its President and Secretary at the banquet at Hotel Astor, endeavored to express its deep appreciation of a function which made the fifteenth annual meeting memorable.

* * * * *

The Presidents Get Together. After the annual meeting the President of the National Board of Fire Underwriters and the President of the National Fire Protection Association went over to Washington to see the President of the United States; and in a very few minutes the President of the United States said things to the other presidents which indicated that if his brilliant new Secretary of the Interior were not so admirably equipped to point out the fire hazards of the United States to the citizens thereof, the President of the United States could do it himself and do it well.

But it was not any vagrant inclination to see what President Taft knew about the fire waste that took President Babb and President Merrill to Washington. Their call at the White House was incidental. They went over to the capitol as good citizens, on the invitation of the House Committee on Public Buildings and Grounds, to advise with that committee on the subject of protecting Uncle Sam's premises from fire.

The Associated Press dispatches of May 31st describe the visit of the presidents as follows:—

"George W. Babb of New York, President of the National Board of Fire Underwriters, and W. H. Merrill of Chicago, President of the National Fire Protection Association, appeared to-day before the House Committee on Public Buildings and Grounds, and recommended the establishment of a government bureau of

fire. Following the loss of the state records by fire at Albany and the burning of the Missouri capitol, the House Committee investigated fire conditions in some of the federal buildings and, it is understood, found a number of unsatisfactory items, fire hose being one.

"Mr. Merrill stated that some of the railroads and large industrial corporations maintained departments to cover the work of fire protection in their properties. He said that the bureau of mines and the bureau of standards already have in their employ a staff of competent fire protection engineers and that an example by the government in properly safeguarding its properties, especially those where large numbers of people congregate, would be beneficial to property owners generally.

"Mr. Babb indorsed Mr. Merrill's remarks and referred to a bill introduced in the House for a general investigation of the country's fire waste and insurance rates. The bill carries an appropriation of $250,000. Mr. Babb opposed the measure, saying a number of such investigations had already been made and the taxpayers' money could be better expended for some measure of relief rather than further inquiry. He quoted the Secretary of the Interior as characterizing the country's fire waste as a national disgrace, and showed that comprehensive statistics on the subject were already available in an official publication made under the direction of the experts of the geological survey. Both men were here at the invitation of the committee. They were callers at the White House and the Interior Department."

* * * * *

A High Class Fire. No matter how "high up" the agitation against the national ash heap may be carried, the fire fiend manifests a disposition to maintain a superior altitude. We do not refer at present to the statistics for the current calendar year, which indicate the worst year of fire waste since that of the San Francisco earthquake fire; we refer to actual perpendicular.

The highest blaze ever fought by the New York fire department was discovered one evening recently on the 25th floor of the new municipal building, now in course of construction at Park Row, Duane and Centre Streets. The fire started in a pile of lumber in the south wing near the Park Row side, which had been placed on the 25th floor. The blaze, which is thought to have originated from a heated rivet, was first discovered by men on the fire boat George B. McClellan, docked at the foot of Washington Street, Brooklyn. Fire headquarters was notified, and firemen sent to the building. They ascended to the 20th floor in an elevator, and climbed stairways to the 25th floor, where they found a large pile of planking in flames. As they hurried down an alarm was turned in from a box at New Bowery and New Chambers Street. In the meanwhile the fire had spread to a pile of lumber on the 26th floor. Fifty firemen were taken in an elevator to the 20th floor, and later lines of hose were carried up. It was found that the standpipe connection in the south wing of the building did not extend above the seventh floor, and as a last resort it was decided to use the standpipe connection in the north wing of the building, which did not extend above the 21st floor. The firemen tried to extinguish the fire by throwing on sand, but the blaze was beyond their control. "We found that the stand-

pipe connections on two lower floors had been left open," said Chief Hayes, "and the men were compelled to whittle lumber and plug up the openings before the water could be carried to the 21st floor. This caused a delay of several minutes." Lines of hose were attached to the standpipe connection on the 21st floor and an engine stationed in City Hall Place, a block distant, pumped water to the 25th floor under a pressure of 270 pounds. "The firemen's lives were endangered, owing to the fact that a portion of the two upper floors had not been floored over," said Hayes, "and in going about on the floor beneath the 21st, the firemen were compelled to walk in line and carry a lighted lantern." The fire was soon extinguished after the firemen got the water.

* * * * *

New York's Water Supply. It is a pity, in view of the limited supply of water now available to the big metropolis, and the possibilities of a real water famine, that sea water cannot be used entirely for extinguishing fires. The city has been exceptionally free from fires thus far this year, where the high pressure system has been used, and the drain on the city's supply from that source has consequently been abnormally light. The recent rains have improved conditions, but not to the extent that one would naturally suppose. They have only sufficed to satisfy the earth's thirst and revive vegetation. Consequently the run-off has been almost nothing, the water not soaking further into the ground than a few feet, so that the underground streams which supply the springs, which in turn supply the brooks, received absolutely no influx. The reservoirs, therefore, received no more water than actually fell on their surfaces, leaving the situation little improved. The need of exercising rigid economy in the use of city water is again made plain, but when fire comes, economical use of city water is out of the question. The corroding effect of salt water on the pumps and its other interferences with their operation precludes its use, unless in extreme emergency. Moreover, salt water practically ruins merchandise and destroys the underwriters' salvage. To use it exclusively in the high-pressure service would mean that thousands of dollars worth of property would be irretrievably ruined. Another reason why salt water may not habitually be used for fire purposes is the fact that it is polluted, and as it dries in the streets after being used, it becomes a menace to public health.

* * * * *

Dwelling House Hazards. As we gradually get away from the old fashioned methods of heating water and cooking with coal, thus eliminating the hazard of hot ashes carelessly disposed, we encounter new hazards in the new apparatus that need to be looked after. These hazards are, however, generally due to improper installation at the start. The "instantaneous" water-heater, popular in bathrooms of small residences, is an innocuous device enough, and yet some-

times causes fire by "flashing"—the flaring out of the gas flame into the room, caused by a gust of wind sweeping down the vent pipe. Towels, etc., are thus easily ignited. This can be prevented by carrying the vent above the combing of the roof and having at its top a movable cone deflector so as to have the opening facing leeward, the deflector turning with the wind.

The vent pipes which end in blind attics or do not go through the roof are a menace, as they focus the heat on one point, and if the heater is in constant use for a while, so concentrate the intense heat as to cause a fire.

Vents to gas ranges are also frequently not properly looked after and eventually cause fire. One of our members, who is a careful observer, recently called our attention to this hazard in a personal letter. He writes:—

"I have recently been in several residences in course of construction at Evanston and was astonished to see the method being provided to carry away the vapors, smoke and odors from the gas-heated cooking ranges.

"These were not cheap houses by any means, as judged by the money value, but the conclusion had been reached by the architect or builder that in the city with fuel gas available, a chimney for the kitchen was an unnecessary luxury, and if a three or four-inch stovepipe from the oven and broiler of a gas range could be stuck into the wall, anywhere, the desired appearances had been observed and nothing else was necessary.

"These houses were frame and constructed of wood throughout, with the exception of a thin stucco plaster on the outside, but notwithstanding this fact and without any regard to the possible, if not most probable, result, a bare No. 28 U. S. gauge galvanized iron tubing was concealed in a four-inch wooden lath and plaster partition in a more or less straight run from the kitchen to the roof.

"It takes a very short time for a smoke flue from a gas oven to become heavily coated on the inside with a greasy inflammable mass, and then when a dripping, broiling steak bursts into flame it may complete the job.

"To somebody's credit (?) let me say that in one instance a single wrapping of thin asbestos paper had been applied to the conductor piping held in place at intervals by a twisted wire. It looked better, at least."

* * * * *

The St. Louis Way. A fitting recognition of the public value of the work of our active member the St. Louis Fire Prevention Bureau has been made in a very unusual provision of the St. Louis municipal code, under which the Bureau inspector has authority to prosecute for violation of the city statutes. Following is the section making the said inspector a city officer:—

Section 37. Inspector on request Fire Prevention Bureau—no compensation from city. In addition to the force provided herein, an additional inspector shall be employed, with the advice and consent of the mayor, upon written application of the St. Louis Fire Prevention Bureau, who shall devote his time to the examination and supervision of buildings in process of construction in the city of St. Louis, and who shall report to the Commissioner of Public Buildings all violations of this or any other city ordinance relative to the same. The said inspector shall serve without compensation from the city, and hold his position until removed by the mayor at the request of said St. Louis Fire Prevention Bureau.

That such a working arrangement as this gets results, is indicated by a clipping from the *St. Louis Globe-Democrat* on the subject of a case brought into court by the inspector of the Bureau, which reads as follows:—

"Accompanying his total of $1,250 in fines, with a lecture, Judge Pollard in the Dayton Street Court Friday scored William D. Evans, proprietor of the Merchants Hotel at Star Square and Olive Street, for alleged lack of fire escapes.

"Evans was assessed the heavy tax on four charges: $500 for failure to have a clear passage leading to an inside fire escape; $250 for dumping hot ashes in his cellar; $250 for failure to equip his rooms with fire alarm bells, and $250 for failing to employ a night watchman.

"Evans said he had put in the fire bells since the charge was made, but the fine was not lifted. He also put on the stand Richard Walker, a negro man-of-all-work, who said he acted as night watchman, clerk and call boy.

"This negro said he relieved the clerk at 1 a. m., after which he patrolled the hotel every half hour. Judge Pollard held this work did not constitute real watching.

"The Building Department testified, through Inspector William J. Landry and J. J. Denny they had found hot ashes on the wooden floor of the hotel cellar, and Evans, on their complaint, after that had the ashes dumped on the concrete part of the cellar.

"The inspectors said that to reach the fire escape it would be necessary to go through a room and as this probably would be locked during its tenancy, it would be required to batter the door down to get access to the escape.

"Judge Pollard referred to the recent New York factory fire horror and the Iroquois Theatre disaster in Chicago as reasons why he meant to go the limit in handling fire cases. He warned all hotels to properly safeguard their guests."

* * * * *

A Satisfactory Fire. If any kind of a fire can be called a satisfactory fire it is one which is successfully caught in the trap laid for it by the wary fire prevention engineer. A standard motion-picture-machine booth is a "fire trap" in a good sense. A note from our active member the West Virginia Inspection Bureau on such a fire shows the good behavior of such a booth, and shows that the "non-explosive" film will burn, at least. The booth is about 10 x 10 x 6½ feet, having one entrance door and peep and picture openings for two machines. It is lined throughout with 1-8 inch asbestos covered with No. 20 B. & S. gauge metal with over-lapping joints, securely held in place. The entrance door is of same construction as the booth, and is hung on outside of same over-lapping opening on sides, top and bottom, three inches.

The peep and picture openings are protected by sheet iron doors somewhat larger than openings, held suspended above same by strings and fuse. These doors are arranged to slide in over-lapping grooves of metal.

The vent for keeping the booth cool opens directly into a chimney in the brick wall of the building. All shelves, supports, tables, etc., inside of booth, are either metal or asbestos and metal clad.

The electric wiring in the booth is all in conduit or metal moulding,

except a few feet of asbestos wire to machines. All cut-outs are in an iron cabinet, with door always closed, except when the renewal of a fuse is necessary. There are four booth lights, all in metal moulding with short reinforced cord drops. Machine circuits are controlled by approved metal enclosed knife switches.

The building in which the booth is operated is three stories, and is of the ordinary brick construction with wooden joists and floors. It is located in the center of a congested block. The report is as follows:—

"The fire was started by one of the so-called 'non-explosive' films catching fire in the machine during an entertainment. Very soon the fire was communicated to four or five other films which were being rewound at the winding bench. All were consumed.

"The heat developed was intense. We visited and inspected the booth as soon as it was cool enough to be entered. It gave every evidence of intense heat, and at the time of our inspection was still so hot that we could not remain in it except for a very short time. Everything combustible in the booth was destroyed, but the booth itself was uninjured.

"The booth building also was uninjured except that the entrance door was scorched and charred, further damage being saved by the timely arrival of the fire department. We had not given certificate on the booth, for the reason that this entrance door was not in accordance with specifications—the spring supposed to close it being on the inside, instead of the outside.

"In our opinion, the booth had a very severe and practical test and withstood the same in a most satisfactory manner."

Public Education.

Speaker's Bureau.

A number of our members contributed good work to the speaking campaign during the last quarter. Both the Boston and the New York Society of Architects arranged special meetings to discuss the fire waste. The Boston Society's meeting was in the form of a dinner at the Parker House. The fire commissioner and fire chief were present and spoke. The N. F. P. A. speakers were Mr. F. E. Cabot and Secretary Wentworth.

At the New York meeting Secretary Wentworth was the speaker and said things about the Boston schoolhouses which, telegraphed to Boston, created a stir in the Hub and brought forth interesting, if unconvincing, interviews from the Mayor and other officials. The following extract from the *New York Evening Post* gives the Secretary's criticisms:—

Speaking at the meeting of the New York chapter of the American Institute of Architects in the Fine Arts Building last evening, Franklin H. Wentworth of Boston, Secretary of the National Fire Protection Association, made the statement that Boston had abandoned first-class construction in its public school buildings and that the new schools were not fireproof.

"I cannot urge upon you too strongly your responsibilities in regard to the housing of your children in the public schools," he said. "Schools, of all build-

ings, should be placed wholly out of the burnable class. I wish I might point with pride to my own city as an example for you to follow, but I must make the humiliating admission that our former high standards have recently been lowered, and that second-class construction has been deliberately chosen.

"The Boston Board of Schoolhouse Commissioners is still keeping to fireproof construction of boiler rooms and coal pockets, and is enclosing corridors and stairs with fireproof walls, and building corridors and staircases of fireproof material, but where floors and partitions were formerly also fireproof, heating and ventilating ducts of masonry, and walls furred with terra cotta, this first class construction has been abandoned. At present, floors, except over the boiler rooms, are being framed with timber; the partitions between classrooms and wardrobes are of stud; the outside walls are furred with wood, and heating and ventilating ducts are of galvanized iron. Instructions were given to enclose these ducts in wooden frames, but I cannot believe that any such hazardous construction actually has been carried out.

"The men responsible for this assume that no fire is apt to start except in the boiler room, that the children can protect themselves by fire drills, and that metal lath makes wooden partitions safe; and they say that they didn't have the money to build as they have been building. Unless, however, I have lost the faculty of reading figures, these new schools of inferior construction are actually costing more per pupil than those which were built fireproof. In answer to the cry of poverty, given as the only excuse for this action of the commissioners, I declare that any reputable citizen of Boston could have gone up Tremont Street with a subscription paper and collected enough money to have kept up the standard.

"Any man with a child in a Boston school would be capable of a sacrifice to know the child was absolutely safe from fire."

Since the above remarks were made it transpires that the conditions in Boston are even worse than therein indicated, the current "economies" of the new city schoolhouses being effected by the elimination of all fireproof material except over the boiler rooms. Floors and partitions are now to be all of wood, including the corridors, and even the staircases are in some cases of wood and in no way cut off from the inflammable interiors.

* * * * *

President Merrill made four speeches during the quarter, not counting his happy contribution to the decennial banquet festivities of the Insurance Society of New York at Hotel Astor, May 23d.

At the meeting of the Fire Insurance Institutes of America in Chicago in May he pointed out the progress of that city in the installation of standard fire appliances in comparison with New York and Boston—especially Boston. He said:—

"During the past two years Chicago has led all of the cities in the country in the number of properly certified fire appliances, such as fire doors, fire windows, hand extinguishers and similar devices installed in its buildings. There seems a possibility that this city may be the first among the larger cities of America to enforce adequate and comprehensive specifications covering the quality of hose to be accepted for use by its fire department. New York recently tried to do this and failed, and in many other cities the characteristically careless methods still prevail which assume that manufacturers' guarantees to replace any hose which proves defective in practice are sufficient, even though a large additional fire loss results from the failure of shoddy material to hold together in service.

"New York is the second city in the list in the number of Standard fire

appliances installed, and has made so marked a gain during the past six months that it is probable Chicago will drop to second place within the year.

"It is interesting and instructive to note that the cities of Texas are showing a lively appreciation of the necessity of adopting and applying Standards of this character, and occupy conspicuous positions in the list referred to.

"Staid and self-sufficient Boston occupies the bottom of the column."

* * * * *

On May 19th President Merrill spoke at the annual meeting of the Mill and Elevator Mutual Fire Insurance Field Men's Association and entertained the delegates at the Laboratories. He also spoke at the meeting of the State Fire Marshals held in Chicago, and on June 27th attended the annual meeting of the Illinois State Board of Fire Underwriters at Delavan, Wis., where he delivered a speech which sparkled with the epigrammatic utterances characteristic of him and which the newspapers are so fond of copying. Here are a few of the most trenchant of them, culled from his address:—

Everyone who has traveled by railroad appreciates the value of the civil engineer. Everyone who uses electric lights knows that electrical engineers are necessary to design them and make them work. In considering problems of fire protection and fire prevention, remember to seek the advice of trained fire protection engineers. The profession of fire protection engineering is an honorable calling. He who devotes his life to safeguarding the lives and property of his fellows is surely doing no small thing for humanity.

With pardonable pride a property owner may point to a spotless fire record in answer to suggestions for interior fire doors and exterior protection against exposures, but he will think little of your business ability if you admit such evidence as competent and sufficient.

Beware of trade names as absolute criterions of value in fire appliances. Products made from the sap of the maple and from colored glucose are both called maple syrup.

Twenty million certified fire appliances bearing the labels of Underwriters' Laboratories were marketed last year, not only because the insurance companies recommend them, but more largely because buyers and users prefer the certified article. If someone would perform the same service for spring waters and woolen cloths and lawn mowers, many of us would support him without consulting our doctor in the first case, our tailor in the second, or our hardware dealer in the third.

An exhibit of a fire appliance sometimes shows that a man can make a creditable device. The label of Underwriters' Laboratories shows that he does.

The Laboratories' labeling service is superior to the pure food law or the certified milk ordinances, in that the fellow who controls the labeling has a direct financial interest in common with the consumer in seeing that he gets unadulterated goods.

Beware of the extinguisher which will act to best advantage in putting out a

gasolene fire in a cuspidor. We have few gasolene fires in cuspidors. It is hard to educate fires to meet the limitations of specialty extinguishers.

Look out for shoddy fire hose. The demands for rubber in automobile tires, and other circumstances, has caused lots of poor hose to be made recently. Manufacturers' guarantees as to replacements do not cover lives that are lost or buildings that are burned. Often they do not even cover the hose if it can be shown that a horse stepped near it or a wagon ran over it.

It is always easier to get a correct analysis of the hazards of a manufacturing process before the risk burns than to leave it for the adjuster to prove violation of policy conditions from evidence left in the ashes.

To publicly read a list of the recent fire horrors in this country, a man needs a lot of breath. The effort sounds as long and solemn as an announcer at a railroad station repeating the stops of a cross-country local.

Some people opine that they can tell what's inside a fire door after it's hung by looking at the tin covering. If the marvelous man with the X-ray eye really does exist, I am in a position to offer him an attractive salary.

Similarly we hear of the wise one who will chew awhile on a piece of rubber hose lining, or so-called rubber wire covering, and tell how much pure para gum there is (not) in it.

Being a second cousin to an uncle of the owner's wife may be helpful in securing a line, but an acquaintance with the hazards of the risk will be appreciated both by the underwriter and the assured.

As a business getter the label on the superior fire appliance can sometimes be utilized to greater advantage than the label on the inferior cigar. This for the reason that a man may be more interested to receive full value for money expended for fire protection than to have someone else choose his smoke.

On the question of annexes I call your attention to the fact that $20,000 contributed by the National Board of Fire Underwriters is to be invested in another annex to Underwriters' Laboratories. Like those that have preceded it, it will be constructed so as to avoid the chance of having a loss.

Buyers of cottons and calicoes always have an opportunity to shake hands with the head of the house when they are in the big city. Buyers of insurance must have a loss before they see anything but a facsimile of his autograph.

We pay a fire tax whether we insure or not. It is in the price of everything we eat and everything we wear.

The place where a fire can't occur is the place where one generally starts.

It was on this occasion that the President gave out the remarks of President Taft, made during an interview with Mr. Taft in Washington.

Mr. Edward V. French, of Boston, for many years chairman of important committees of the Association and at present chairman of our committee on Private Fire Supplies from Public Mains, made two notable speeches during the quarter at most important gatherings. At the Congress of Technology, held to celebrate the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology, he spoke on "The Prevention and Control of Fires through Scientific Methods"; and at the meeting of the New England Waterworks Association he presented a paper on "Desirable Pressure at Hydrants." On this subject, among other things, he said:—

"The problem is the amount of pressure it is desirable to have at hydrants under various conditions. If steam fire engines are to be depended upon, then but a few pounds' pressure may suffice to force the water out of a hydrant as fast as a steamer would use it. It is true that a somewhat higher pressure helps the steamer, but this is not essential. The cities of New York, Philadelphia and Chicago are examples of very low pressure supplies. In these cases the pipes are little more than underground canals to which the steamer gets an inlet through the hydrant. New York and Philadelphia already have special high pressure systems for fire use only. If fire engines are not to be used, the hydrants must have sufficient pressure to furnish good fire streams.

"The standard to-day is discharged by the 1½-inch smooth nozzle, giving 250 gallons per minute. This size is best adapted to ordinary work. On large buildings larger streams are desirable, and can be obtained by siamesing double lines of hose. The pressure needed at the hydrant to furnish a standard stream depends on the length of hose.

"Two and one-half inch cotton rubber-lined hose, now almost universally used in fire department work, causes a loss by friction of about 14 pounds pressure per 100 feet of length of hose with 250 gallons flowing. This is for hose having a smooth rubber lining. Some hose is sold in which, due to faulty methods of manufacture, or to a desire to unduly cheapen the product, the rubber linings are not well backed up, and a very rough interior results. Such hose may cause a loss of nearly double this amount. Of course such inferior hose should not be used. For any ordinary fire fighting, even where the hydrants are spaced closely together, hose lengths of 250 to 350 feet will be necessary. This gives sufficient leeway for going around corners, into alleys, up ladders, etc., and is essential for reasonable facility in getting at the fire. It is fair to take an average of about 300 feet as the length of hose usually needed.

"As soon as the built-up section of a town or small city comes to be somewhat closely covered and of moderate area, a capacity of about ten streams, requiring 2,500 gallons per minute, is needed. In our cities of medium size, such as Springfield, Lynn, Worcester, 20 to 30 streams should be provided for, and to give a good margin for water used by automatic sprinklers, inside standpipes, or wasted through broken connections for ordinary services such as are sure to occur in any considerable fire, an available capacity of 10,000 gallons per minute has been generally advised, and is necessary for reasonable safety, with the construction now common in cities of this general type. These quantities of water must, of course, be delivered in addition to the normal consumption of the community.

"The total amount of water used in even large fires is not as great as frequently thought. A fire, for example, requiring ten streams for five hours, would use 750,000 gallons. It is also of vital importance where hydrants are to be depended upon for fire streams that they should be so near together that the whole capacity of the water supply may be concentrated on any point where the total strength of the system might be needed, and this should be possible with the use of

hose lines generally not over 300 feet in length. This would require hydrants much closer together than is the usual practice. Hydrants are, however, much cheaper than hose or steam fire engines.

"Where steamers are depended upon, it is very common to use hose streams 500 and 600 feet in length, and frequently longer, but this is undesirable, even with steamers, and a great waste of energy is simply absorbed in friction. With ordinary hydrant pressures depended upon, such needless losses cannot be tolerated. When a conflagration threatens to sweep our wooden cities, as at Chelsea and Baltimore, hose carts can quickly lay lines in different sections, making it possible to surround and drown a fire which would get away in the time lost by moving steamers and getting them in operation. Radical improvements in construction would be the best way to stop conflagrations, but this is a remedy which will come but slowly, and until our standard is greatly improved there is nothing which would give the probability of checking a conflagration as well as a good pressure available at every hydrant, supplied by pipes of such size that each hydrant could at any moment furnish two, three or four efficient fire streams. A town or city with such a water supply can make a very material saving in the cost of the fire department over what would be necessary with low-pressure water and sole dependence on steam fire engines. In such a city it would, in many cases, be necessary to keep only a few steamers in service, and in some cases none at all."

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In his speech at the Congress of Technology, Mr. French traced the development of fire protection engineering from its beginnings in the cotton mills of New England—in the first common attempt of those properties to check the fire hazard—to the modern systems of automatic sprinkler protection. He said in part:—

"It was early found that the old steep roofs with their inaccessibility and large amounts of fuel were especially hazardous features, and as they burned off solid flat roofs of plank were provided, while many mills were induced to remove the bad roofs without waiting for a fire. The advantage of good construction was apparent from the beginning, and some mills in New England, though built over seventy-five years ago, still stand with floors of heavy plank and timber, and with stairways and elevators in brick towers. This type of construction early became known as slow burning, from the fact that the solid masses of wood in the timbers and plank resisted fire for a long time before being sufficiently burned to be seriously weakened. Contrasted with this construction is the ordinary type using joists and thin floors, in which the surface exposed to the fire is much greater than when plank and timber are used, and in which the wood is in such small pieces that a little fire quickly destroys all strength, thus resulting in a quick burning structure.

"The need of having floors tight so that no vertical openings would exist through which fire could quickly pass from story to story was early recognized. It later became the practice to enclose the main driving belts in brick towers and in practically all of the older mills, where the belts were originally carried from water wheels or engines through the floors, making considerable openings, incombustible partitions have been built around the belts so as to eliminate this danger. Special consideration was given to isolating hazardous processes and one of the first steps was to put the picker room of cotton mills in an outside building, where the frequent fires, which were inevitable, could quickly be extinguished without endangering the main part of the plant.

"In a similar way all other processes containing peculiar hazards have been dealt with, each case being considered on its own merits and the solution best fitting the conditions adopted.

"At first it was a common practice in testing a fire pump to throw streams over the mill tower, getting a rough estimate of the capacity and condition of the pump. As more equipment was provided better methods of testing became necessary. It was found that the ordinary tables for the discharge of water through nozzles were in error and comprehensive tests were arranged under conditions where nozzles of different types could be compared, the height of streams noted and the limits for varying pressures and different sizes of nozzles determined. At the same time the possibility of using better made nozzles for measuring water was demonstrated. These tests, carried on mainly by technology men, resulted in the standard fire stream tables now universally used. This gave a convenient and accurate means of testing waterworks systems and fire pumps, and marked a distinct advance in the whole science of water measurement for such conditions.

"After the very early plunger pumps, rotary pumps came into general use with water wheel drives. Later, as steam became more common, steam fire pumps were installed, and one of the first steps was to point out the need in fire pump service of making the steam cylinder larger than those commonly provided for service pumps, so that the low steam pressure used in those days could develop a high water pressure. As steam fire pumps became common, tests by inspectors showed many failures. Parts would break; pumps would be found rusted so that they could not be moved; steam ports and water passages were so small that the pumps frequently could not be driven under fire pressure to at all their rated capacity. The problem was studied and with the co-operation of pump makers a special fire pump was developed, more rugged in design, all moving parts rust-proofed, and with water and steam pipes ample. The result was a thoroughly reliable fire fighting machine of large capacity. This is now the type of pump universally used in fire protection work and known as the 'Underwriter.'

"In a similar way progressive ideas have been applied to rotary pumps and in later developments to the centrifugal pump, now coming somewhat into use for fire purposes. In the same spirit of thorough investigation, hose, play-pipes, hydrants and the many other devices used for protection against the fire have been studied. Specifications drawn on scientific lines have been developed and the whole subject brought to a thoroughly scientific basis.

"In the early mills pipes of small size were first carried from roof tanks and fire pumps to standpipes and yard hydrants. It was soon found that more water was needed and cases developed where, when the full capacity of the pumps was desired, it was found that the pipes were altogether too small to carry the water to the point where it was needed. This brought about a study of the lay-outs in all the protected factories and engineers, employed by the associated factory owners, revised old lay-outs and made new ones. In this work good hydraulic knowledge is necessary and the aim is to provide pipes of such size that the whole capacity of the water supply available may be concentrated at any point with but a few pounds loss of pressure between the supply and delivery point. In this way is laid out the protective equipment for the mills included in this system so that the greatest efficiency is obtained with proper regard for economy in outlay.

"It is of the most vital importance that the good construction provided at the start and the strong protective equipment installed should be maintained at all times in the best condition.

"Plans of the protected properties were made at first in very simple form, then later in more detail, showing the general characteristics of the buildings, the arrangement of occupancy and the protection. A general view in isometric is also added, which enables one at a glance to obtain a good idea of the relative height and location of the different buildings. The above points, but briefly touched upon, are simply the main features in a broad development which has made the modern protected factory, with its many hazards, one of the safest fire risks known.

"The summation of these various lines of activity has made a system and created the specialty of fire protection engineering. A few examples of typical

cases may be of interest. In the great fire which destroyed a considerable section of Paterson, N. J., about ten years ago, the conflagration was for hours beyond control of the combined fire departments. The fire finally extended to a group of protected mills. The fire pumps in these mills were early put in operation and the mill fire brigades stood ready. As the conflagration approached the mills it was met, driven back and stopped. A map of the city, with the burned area indicated in black, shows its ragged border line drawn parallel with, and but a short distance from, these mills. The scientific methods of fire fighting which had been developed had triumphed and these protected properties sustained practically no damage, and actually checked the conflagration in this direction.

"Fires often started from unknown sources, and there was a constant tendency to attribute them to ordinary causes, without thorough investigation. To such fires the spirit of scientific investigation was applied. It was found that many fires came from the use of oils which rapidly oxidized, causing spontaneous combustion. A large amount of work was done in this direction and analyses, which proved the truth of this fact and suggested remedies, were made. Many fires resulted from hot bearings improperly lubricated. Lubricating oils were examined and tested to determine the friction of bearings lubricated with different kinds of oils. Very great differences were found, and study showed that oil could be obtained which would almost eliminate the danger from hot bearings and which at the same time would not be subject to spontaneous combustion. Thus a very troublesome class of fires was eliminated by systematic study. Goods colored by certain dyes were found to be liable to spontaneous heating under some conditions and fires once inexplicable were easily proved to be the result of this action. Remedies were applied, either by changing the method of dyeing, or the method of handling the stock so as to give a proper chance for airing and cooling, and this danger was practically eliminated.

"The underlying principle in all of this work, be it an intricate problem or a very simple one, has been to intelligently and carefully ascertain all of the facts, using the best scientific knowledge available, and then with the conditions fully known devise changes in methods or provide precautionary features to take care of the difficulties, and do this without throwing serious obstruction in the way of economical and rapid production. It is a work in which the knowledge and skill of the scientific man must be combined with good judgment and an appreciation of everyday business conditions, and there must be constant willingness to co-operate to the full extent with the practical manufacturer. When the work is conducted in this way the gain to the manufacturer in the prevention of fires, the quick controlling of such fires as occur and the safeguarding of his business from troublesome, and perhaps fatal, interrruption by a severe fire, is certainly of the very greatest benefit."

* * * * *

Mr. F. M. Griswold, chairman of our committee on Standard Hose Couplings and Hydrant Fittings for Public Fire Service, delivered a very interesting lecture, May 9th, before the class in manufacturing plant design of Columbia University, New York, which has been published in pamphlet form and will be found very useful in the study of the rudiments of fire protection engineering.

* * * * *

Mr. Henry A. Fiske delivered an address on the efficiency of wired glass windows before the Insurance Society of New York, in which he paid a very enthusiastic tribute to that form of protection and gave a considerable list of fires in which its value had been demonstrated.

Mr. Chas. A. Hexamer, chairman of our committee on Combustibles and Explosives, spoke on the fire waste before the Insurance Society of Philadelphia in May, the address being one of those in the regular course of that institute.

* * * * *

Mr. Powell Evans, chairman of the Fire Prevention committee of our active member the National Association of Manufacturers, assisted by our members Mr. C. A. Hexamer and Mr. Louis S. Amonson, made a lively campaign in Pennsylvania in the interest of the new fire marshal law.

* * * * *

A unique idea in public education was worked out in Chicago in May by our active members the Chicago Board of Underwriters and Underwriters' Laboratories, Inc., in the maintenance of a fire prevention booth at the Real Estate Show. It attracted a great deal of attention, and was conceded by many to have been the best educational exhibit on the floor. The booth was intended as a means of distributing literature on the fire waste and better construction, and as a place where persons seeking advice or information on the best methods of home building, so far as fire protection was concerned, could secure expert advice. Inspector Gadsden, of the Chicago Board of Underwriters, and A. O. Boniface, of the Underwriters' Laboratories, were in attendance, and the amount of interest shown by owners of property in the best methods of erecting buildings from a fire resistive standpoint was most encouraging. The pamphlets prepared by the Committee on Publicity and Education were distributed, together with a number of circulars dealing with dwelling house and domestic fire hazards, especially prepared for the occasion. The Laboratories exhibited its collection of defective electrical devices, while the Chicago Board of Underwriters had sections of frame dwelling construction, showing the hazardous style, with the concealed spaces forming flues running from the top to the bottom of the buildings, and the ease with which this could be improved by putting fire stops in these concealed spaces. The exhibit was so popular that similar exhibitions have been planned for Cleveland and elsewhere.

* * * * *

Secretary Wentworth went to Minneapolis to speak at the annual convention of our active member the National Association of Credit Men on June 14th, and received a cordial welcome from the delegates, many of whom he had met in their home cities during the winter's speaking tour. The attention given by the convention to the question of the fire waste was all that could be desired, the following unusually forceful resolutions being passed unanimously:—

"*Resolved*, That the National Association of Credit Men in convention assembled, recognizing that the present conditions of fire insurance and fire waste are imposing an unwarranted and unnecessary burden upon our people, makes an

earnest appeal to its members and particularly its affiliated branches to double and redouble their efforts to secure relief from these conditions.

"First, By using every means at hand and especially the literature of our Association to give the public in general a thorough understanding of the problems.

"Second, By making a conscientious study of local hazards especially as cited in the reports on cities and towns as issued by the engineers of the National Board of Fire Underwriters and, acting upon them, demand of the municipal authorities that such hazards be reduced or eliminated.

"Third, By endeavoring to secure in every state the enactment of a fire marshal measure modeled as closely as possible upon the bill as introduced, largely through the instance of this Association, in the legislature of the state of New York.

"Fourth, By keeping in touch with the state departments formed under the fire marshal laws with a view to securing from them the highest possible efficiency.

"Fifth, By co-operating with other organizations, such as State Fire Protection Associations, formed to reduce the losses of their respective states.

"*Resolved*, That this Association is deeply appreciative of the advantage which has come from the close relationship it has formed with the National Fire Protection Association, realizing that such connection has helped our Association in laying before the members and the public in general with greater intelligence and effectiveness, very definite and vital facts regarding fire causes and methods of removing common causes of the fire waste."

* * * * *

Secretary Wentworth spoke on the fire waste at the mid-summer meeting of our active member the Massachusetts Mutual Fire Insurance Union at the Devereux Country Club, Marblehead, Mass., on June 21st, and at the annual convention of the National Jobbing Confectioners Association, American House, Boston, on July 13th.

* * * * *

The Secretary was also one of the principal speakers at the annual meeting of our active member the National Association of Local Fire Insurance Agents at Buffalo, July 18th. He said in part:—

"I despair of the American people ever being awakened to their impoverishment by mere preaching. We must bring into operation a more salutary educator,—a much sterner schoolmaster than the mild-mannered speaker on the fire waste; we must place responsibility for fires; we must come to consider every man who has a fire a public offender until he can prove to us that he is not responsible. To do this every state must have an official investigation of its fires. The fire marshal is an imperative public officer. He should be an educator, a statistician and a prosecutor. We cannot even know the actual extent of our fire waste until all the states have such departments and every fire—its nature, extent and cause—has been recorded. And right here let me say that the popular practice of sustaining the office of fire marshal with the insurance companies' money is pernicious and reactionary. A public official paid even indirectly by private corporations is a menace to the integrity of republican principles. I do not need to be told that there is no temptation on the part of the underwriters to swerve such officials from the straight path of their duty. Indeed, I know well that their influence, where exerted, is all for the good; but I object to the principle. It is the principle of the farmers-general, which in other applications once wrought such havoc in France: it is the principle under which private corporations are allowed—nay, in this case *compelled* by law—to tax one class of citizens (the policy holders) to sustain a public official who benefits all. The state should collect its own taxes, and pay its own public officers direct, and not play with vicious principles nor hide behind

corporate barriers even for a public good. The fire waste is a common public impoverishment; the fire marshal is a common public servant, and he should be paid out of the public purse without recourse to or consideration for special private or corporate interests. Every special tax placed upon the insurance companies is a tax upon their policy holders, and is in turn shifted by them upon the consumer who buys their goods; consequently every such additional tax is an extension of the vicious principle of the farmers-general,—the state trading its supreme prerogative for a grab at a fund already existing. It is a refuge of cheap politicians which shames the commonest principles of statesmanship.

"I am not an underwriter, and my thoughts as an engineer and political economist may not seem always practical; but in thinking over this problem of taxation in relation to public education, I conceive that it would be of immense value if you local agents in presenting your bills for premiums could separate the item of indemnity cost from the items of taxation. Your customer now assumes that the whole sum is indemnity. Show him! If you can get your companies to furnish the statistics, show him that he is also paying a lot of special taxes for various public purposes assessed upon him through the companies which are trying to protect him from loss by fire. I commend this thought to your serious consideration. If it is practicable to show these items in your customers' bills, I believe in six months it would provoke such an intelligent revolt among business men as to affect the attitude of the state legislatures and protect your companies from the increasing vicious and reactionary attacks by the taxing bodies."

The speaker declared that the maintenance of fire marshals by the underwriters also sadly hampers the work of arousing the public to combat the fire waste, as it operates to confirm the people in the ignorant notion that the insurance companies are the only interests affected by it.

"The people will gladly pay their own fire marshals as soon as they realize who really pays for the national ash heap."

Mr. Wentworth then took up the problem of the local agent and his responsibilities in fire prevention, pointing out the fact that the work of the National Fire Protection Association had made it possible for every local agent to become an engineer. He said:—

"The whole aim and object of our endeavor is to popularize our scientific knowledge. A striking development of recent years in your business is the rise of the big insurance broker. He hires an expert in fire prevention and goes out and takes the business away from every local agent who is not a real underwriter. But who is the broker's 'expert'? He is generally some young member of the National Fire Protection Association who has spent a few weeks reading its literature. The leading fire prevention engineers of the country make this literature, and the cleverest scientific writers of the country put it into its popular form. This fountain of knowledge is open to one man as well as another on the same terms; and anybody with five dollars a year who knows how to read can easily become his own expert and give advice to everybody else. There are no hidden mysteries in fire protection enigneering, and we do not mean that there shall be any. If we cannot produce a literature that will enable the man in the street to protect himself, and his neighbor, from loss by fire, then we'd better shut up our workshop and go to literary muck-raking or writing spring poetry."

Publications.

Our publications during the quarter have been unusually popular. The Independence Day bulletin was issued in good season to insure a large circulation for it. Many of our members, active and associate, pur-

chased large quantities for local use, and it was reproduced, whole or in part, by many of the publications on our exchange and press lists. This work is undoubtedly most effective. We believe rapid strides are being made to reduce, if not eliminate, the hazards of Independence Day.

* * * * *

The report on the fire in the Asch Building, New York, was highly valued by our members, and the interesting publications of the Committee on Publicity and Education, as well as Mr. F. M. Griswold's lecture at Columbia University—which we were enabled to send out through the courtesy of the Home Insurance Company—found much favor with them.

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The published Proceedings of the annual meeting do not make an inferior propaganda document; but is of course too expensive for general circulation. The subjects and discussions of this year's meeting make the volume exceedingly interesting, and one is well repaid by reading it from cover to cover.

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The beautifully printed pamphlet, "The Prevention of Fire," which we were able to send to our members through the courtesy of the Rochester Chamber of Commerce, is a publication wholly unique in the history of municipal literature. As is indicated elsewhere in this issue, the campaign of this public-spirited body against the fire waste did not cease with the issuance of this booklet.

* * * * *

Two of our active members, the Newark Inspection Bureau, Mr. John M. Hughes, Manager; and the Kansas Inspection and Fire Prevention Office, Mr. Charles E. Eldridge, Manager, are making pretty lively fire prevention campaigns on their own account. The columns of the Newark dailies have given more space to agitation of the subject during the past six months than the papers of any other American city.

Mr. Eldridge edits a series of admirable little pamphlets called "Pointers" which he shoots out at the Kansas press, the members of the legislature, or anyone he thinks may need the gospel. The "Pointers" are frequently illustrated by clever and effective cartoons.

By special permission *Boston Herald*.

It is a deplorable commentary on the state of affairs in American cities that a fire such as that which has swept Bangor almost off the map should be hardly more than a commonplace. It is all the more deplorable that the lesson of the Bangor fire will probably be forgotten in no time and that, with typical American disregard, we shall go ahead and cap the ash heap again. It is to be hoped * * * that the people at large will ponder once again our frightful waste by fire. How wholesome it would be if American cities would really get to work to prove that the burned child fears the fire.—*Boston Herald*.

The Bangor Conflagration.

Property destroyed, value $3,500,000
Contributed by insurance companies, $1,750,000

We have an extended, circumstantial report upon the Bangor conflagration but we do not use our valuable space for it. This is because there is nothing really to say about it but this, which is a paragraph from our report and which applies to any other city of similar size in New England:—

In the area swept by this conflagration the structural conditions were not good, the congested section being almost devoid of the ordinary fire stops such as fire walls and parapets, protected window and door openings. There were practically no fire-proof or mill constructed buildings, neither buildings equipped with automatic sprinklers or other effective fire protection in the burned area. There were many shingled roofs in the congested value district and in the residential district surrounding it.

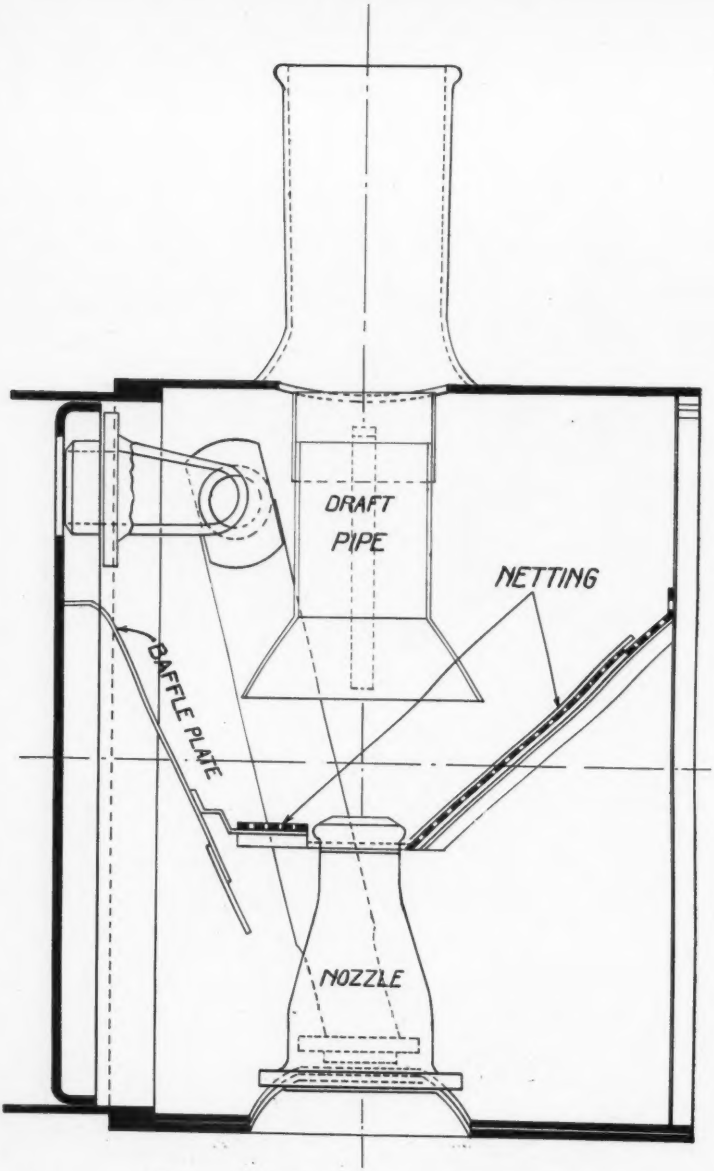


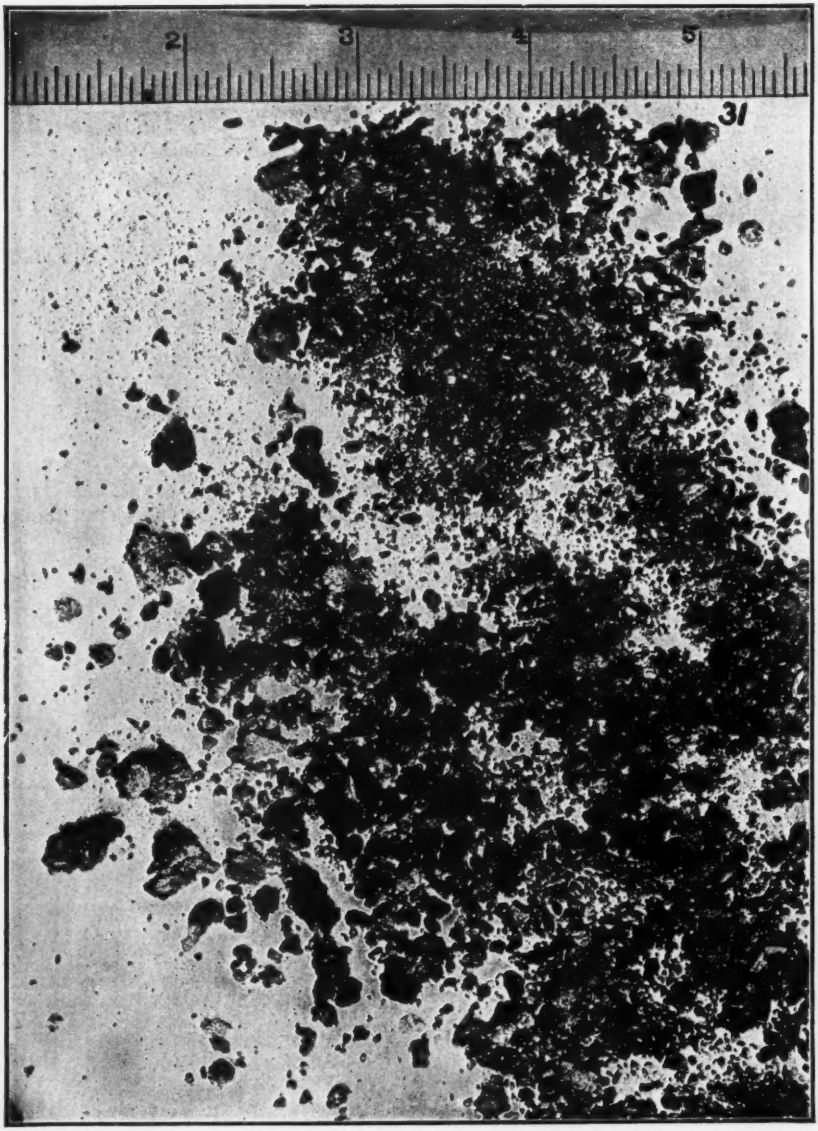
Diagram of front end of modern locomotive.

The grass and weeds are dry; the cotton is unprotected; the heavy locomotive is throwing sparks. Who cares? Can't we grow more cotton?

The Locomotive Spark Problem

Transportation is the greatest factor in the changes and development of social conditions. It is the problem which enlarges the field for action, unites sections in a common interest and links the individual with the welfare of his community. In the social intercourse of the people and the vast exchanges of trade, the railroads stand as the one indispensable source of communication. They most nearly reach perfection in the carrying of weight, shortening of time and minimum of cost. To attain this, not only have the railroads kept abreast of the times but they frequently have preceded the pioneer until the very volume of business they were instrumental in developing has taxed them to the utmost to handle. This has required an increase in facilities through the expenditure of vast sums of money. Adequate trackage has been the most difficult problem, which has been met by a radical increase in the capacity of cars and length of trains. These in turn have required a corresponding increase in size and power of the locomotive.

The locomotive is the most conspicuous instrument in the problem of railroading. As a piece of mechanism it is the wonder and admiration of the ordinary observer. As a power producer under the restrictions of space, unstable base, varying load and exposure to weather it has no equal. The demands upon its service for reliability of power and speed, working to the very limit of its capacity, are not equaled by any other



Locomotive Cinders, Low-grade (Indiana) Coal.

power plant. Its greatest handicap is that of a draft which must be forced and sufficient to consume four to six times the coal per foot of grate area than that of a stationary plant. This requires a draft velocity through the fire-box, tubes, smoke-box and out the stack of approximately a mile a minute. Such a draft is bound to carry with it the finer pieces of coal but partially consumed. These are known as the front-end cinders, common in the seats and berths of cars and in the eyes of passengers. These cinders are also carried alive by the wind, dropped on shingle roofs, dry vegetation or other inflammable matter, and by the same wind frequently fanned into a blaze.

The amount of cinders is continually increasing. Power production is a question of the amount of coal burned, on which depends the amount of water to be evaporated for steam. With the amount of power required for the larger trains and greater speed there has been a conspicuous increase in size of locomotives. Twenty years ago the grate areas of the largest locomotives were approximately 35 square feet. To-day several types have 70 or more square feet of grate. The horse power has been increased from approximately 800 to 2,000 and 2,500. All this has meant a corresponding increase of cinders.

The ordinary supposition has been that it was the occasional live spark which found lodgment in inflammable material and started a fire. Instead, it has been demonstrated that of the coal shoveled into the fire-box, from five to twenty per cent is discharged from the stack as hot and live cinders, thrown at a velocity of nearly a mile a minute, reaching dry shingle roofs, lodged piles of dust, rough bales of cotton, and other merchandise. the dry dead vegetation of summer, both on and off the railroad right of way.

The problem of the live spark from the locomotive stack has been recognized as a public menace from the first use of locomotives. To eradicate them has been the study of railroad men and the brain teaser of inventors, whether with or without knowledge of locomotive performance. This is well illustrated in the records of the U. S. Patent Office, where there have been over three thousand spark arrester patents granted, indicating the numerous forms under which the problem has been approached, and its importance. The lines of effort have been to prevent the cinders getting out of the stack; or to extinguish them by prolonging the path of travel or by pounding before their discharge. Seventy-five per cent of the patented devices are located in the stack, ten per cent in the smoke-box and fifteen per cent in both stack and smoke-box. The first patents covered a screen and eighty-five per cent of all make use of screens. Screens are used on practically every locomotive of to-day.

Screens or nettings are of heavy woven wire or perforated plate of the desired size of mesh. When perfectly clean they offer but little obstruction to the draft, but are liable to become clogged. This is most liable when the locomotive has been standing and the steam has condensed in the cylinders. The first movement of the piston throws the water

Locomotive Cinders, Good-grade (Pennsylvania) Coal.

through the nozzle and onto the screen. The soot in the smoke will gather, and as the screen is clogged the draft area is diminished so that soon the steaming is reduced accordingly. The pounding of the cinders wears fast on the screens and any holes will let through the larger live cinders. Official inspectors find many defective screens.

The artificial or forced draft of a locomotive is formed by the exhaust from the steam cylinders being forced through an exhaust nozzle located in the smoke-box directly beneath the stack. The discharge through the stack carries with it the air or combustion gases, thereby forming a partial vacuum in the smoke-box. This is replaced by a rush of air through the fire and tubes, to be in turn discharged through the stack. In the smoke-box in front of the tubes is a plate diaphragm projecting downward and forward. This is to direct the current of gases below the top of the nozzle and the screen and to concentrate the flow of gases so as to carry with them the cinders at a speed which will force them through the screen to be carried out the stack with the steam jet. This method is the universal "self-cleaning front-end" of to-day. The practice has developed in recent years, for the increasing amount of cinders could not be retained in the smoke-box without obstructing the movement of the gases or smoke. This discharge of a great quantity of hot and live cinders has, of course, added greatly to the fire danger.

While the locomotive spark is known and dreaded in every section, nowhere has it caused such devastation and aroused such effort to combat it as on the northern boundary of the United States, in the forest section extending from Maine to Washington. Here the effort at conservation for the present and future has been most heeded by the property owners and public, the legislatures, and even the railroads themselves. This undoubtedly has been largely due to the absence of insurance for forest losses. The fire waste could not be saddled onto the many through a loaded insurance cost. Therefore the property owner or public has moved to protect itself and reduce unnecessary fires. Also in the forest section is being learned the first great lesson in fire prevention. As the fire starts, first as a mere blaze in a bunch of grass or clump of bushes, spreads to a dry marsh or heavy underbrush and slashing of cut-over land and finally reaches the very tree tops, it keeps gathering volume and momentum until it becomes a holocaust which sweeps everything before it. An experienced forester well states the lesson, which is that one man with the proper facilities could put out 100 of the incipient fires easier than 100 men could fight one conflagration.

The forest fire hazard has been recognized and studied by the U. S. Forestry Service, the various State Foresters, the Public Service Commission, Second District, of New York; and particularly, after the misfortune of 1910, by all public officials and timber owners, as illustrated in the conferences held at St. Paul and Spokane in December, 1910.

While locomotive sparks were recognized as only one of several causes for forest fires, yet they were a conspicuous factor contributing to

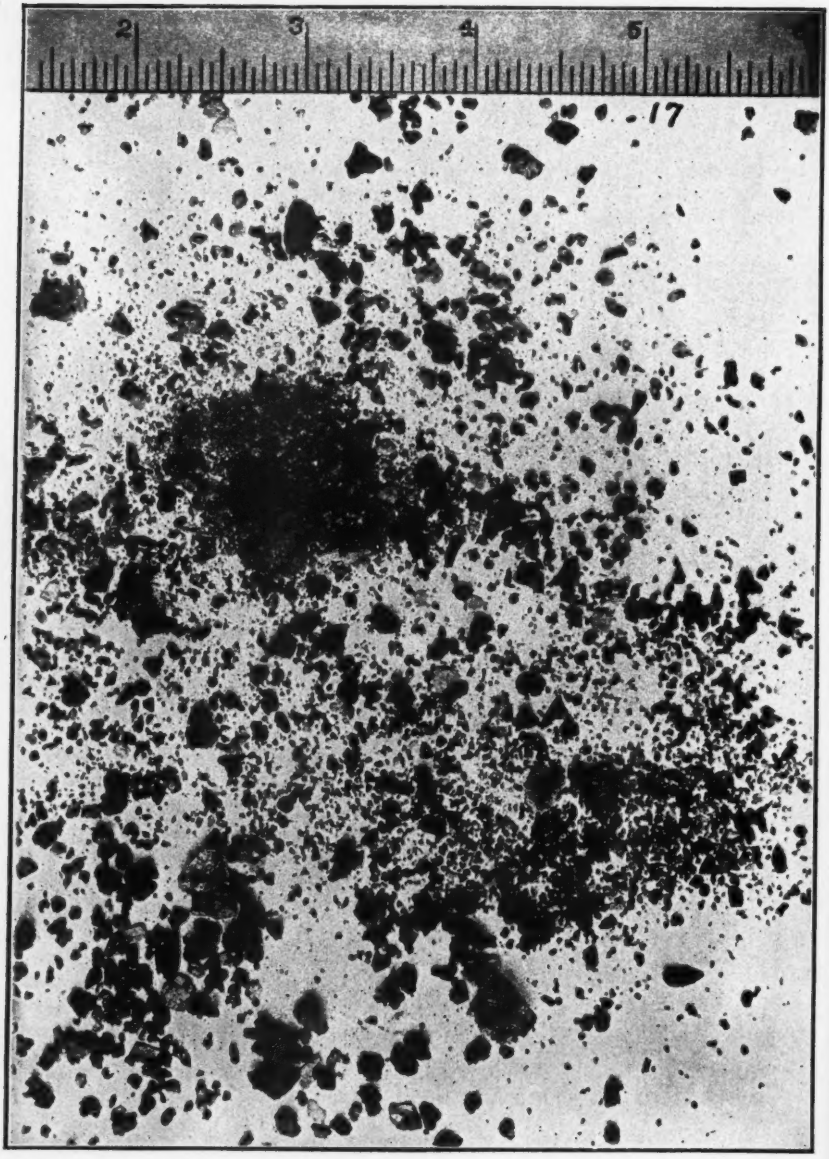
Locomotive Cinders, Lignite (Wyoming) Coal.

the loss, requiring more supervision than any other cause, according to the proportion the rights of way bore to the total forest area. The following are some facts relating to locomotive sparks in the forest sections brought out during 1910.

The U. S. District Forester for Montana and Idaho estimated a loss to Government and adjoining timber of six billion feet, or a total of $21,500,000, caused by 1,679 fires, 56 per cent of which started on the railroad rights of way, and in spite of good co-operation by the railroads. In the forests adjacent to railroads 80 per cent of the fires were due to railroad operation and 90 per cent of these due to sparks from locomotive stacks. This was a fire for every two-thirds mile of track. These narrow strips of railroad tracks required 10 per cent of the patrol service assigned to 18,300,000 acres of territory. The total patrol service cost $863,000, and hence fighting locomotive spark fires cost $86,300 over about 1,400 miles of track. The fires in Washington and Oregon were not as serious, largely due to an earlier enforcement of laws, the cleaning up of the railroad right of way and the use of oil-burning locomotives. In California but ten fires were attributed to locomotive sparks, because of the universal use of crude oil for fuel.

The forest fires in Minnesota during 1910 attracted attention through the burning of the sawmill towns of Spooner and Beaudette, causing a loss of about $1,000,000, involving over $700,000 insurance. The cause for this loss was traced to four fires. One, the most distant, started by settlers, and three by locomotive sparks which had been allowed to smoulder until fanned into a conflagration by a gale of wind. In addition the forestry commission reports 183 forest fires started by locomotive sparks, with a damage of at least $377,000, and 17 prairie fires from the same cause with a damage of $16,855. Some years ago New York State, recognizing the commercial and recreation value to the present and future generations of some of the beautiful wilderness within its borders, set aside 2,400 square miles to be known as the Adirondack Forest Preserve. Within this territory there are 375 miles of railroads, on 19 miles of which crude oil was used as fuel and no fires caused. After disastrous fires in 1893, 1899, 1903 and 1908, in which not only was the tree growth destroyed but also the forest floor which would sustain vegetation for a new growth, an investigation was made by the Forest, Fish and Game Commission and a hearing given the railroads and all interested by the Public Service Commission of the Second District.

This hearing developed several points of interesting information and exhibited the railroad managements unfavorably in efforts to shift the blame, deny liability and finally, when their liability was proven, to demonstrate that they would be bankrupted by any state interference. New York State seems to have been fortunate in a Public Service Commission and Forest, Fish and Game Commissioner with ability to thoroughly investigate facts and properly analyze every position taken by the railroads.



Locomotive Cinders from Gas Coke.

The investigation showed that only about 25½ per cent of the fires were caused by the railroads as against the 70 to 90 per cent assumed. A small number of such fires were traced to coals from broken grates or dropped hot from the ash pan. The testimony was that during a windy day in the drouth season two men with a gasolene speeder carrying chemical fire extinguishers and following trains could not patrol five miles of track and prevent spark fires spreading out of the right of way. The Superintendent of Forests reports a personal experience where a locomotive set four fires in less than a mile. The patrolman was able to put out three, but the fourth got away. Yet under the same dry conditions there was no record of such fires started between 8 o'clock p. m. and 8 o'clock a. m. This is undoubtedly due to a heavy dew caused by the warm night air coming in contact with the colder ground, and has led to advocating heavy freight service at night. The Commission to-day permits coal-burning locomotives for night service in sections properly patroled.

After considerable interesting testimony and argument the finding of the Commission was that the State must be protected against the locomotive hazard. This was shown forcibly in the $170,000 forest loss in 1908, of which $104,000 was caused by railroads. Remedies offered by the railroads were mere improvements upon or corrections of past practices. No reliable coal-burning devices were recommended. Electrification was prohibitive. Therefore crude oil fuel was ordered for seven months of the year, though the Commission acknowledges an increased expense of $37,000 for about 50 locomotives as against the $123,000 estimate of the railroad. During 1909 and 1910, 33 locomotives were equipped for oil fuel at an average cost of $1,000 per locomotive, including tanks. Without definite information the fuel cost has been estimated at 40 to 50 per cent increase. This may illustrate the maximum cost of the protection which will be required when the rights of the public are properly looked after.

Locomotive spark losses in the forest sections have been particularly considered, because it is in the forest that a fire started may burn longest unnoticed, spread over the greatest area, be the most difficult to fight and at present jeopardize the most public property. More effort has therefore been made to reduce the hazard in such sections by legal and preventive measures than has been done elsewhere. In the settled sections locomotive spark losses in the aggregate are large, yet the amount is unknown, because such losses receive no official attention and the property owner is supposed to seek insurance protection, which is in no respect a preventive measure.

Every person doing business on or along the railroad right of way knows of buildings burned and crops destroyed by fires set by locomotives, yet there has been no public interest in the burden of such losses to the community. This burden is partially indicated by the amounts paid by the fire insurance companies for spark losses. No joint record of these losses is available, but it is known that four Mutual companies, largely on

flour mills and elevators, during 1910 paid over $160,000 for locomotive spark losses. These companies make a specialty of mills and elevators which are adjacent to railroad tracks and switches, yet their business is but an insignificant portion of the total of such losses sustained by over 150 other companies insuring similar property. There is always an additional loss of more than 30 per cent on the uninsured portion and a demoralization of business which frequently ruins the property owner.

Probably one of the most difficult products to handle and protect, from both the shippers' and railroads' standpoint, is cotton. The cotton is taken from the field to the cotton gin and packed into bales of 500 pounds each with a coarse jute covering. These bales are carted to the railroad station, frequently only an uncovered platform, for shipment to the compress for pressing to one-fifth the original size so as to be less bulky for export shipment. Though representing a large quantity of inflammable material, with a covering easily ignited, such bales are frequently exposed to the greatest danger from hot locomotive cinders. From their receipt at the country station to the compress, and then to the wharf or cotton mill, they commonly receive little proper protection. The Cotton Insurance Association at Atlanta, Georgia, reports that 90 per cent of cotton fires in transportation are due to locomotive sparks. Conspicuous examples of the locomotive spark hazard were exhibited in the the destruction of two compresses in 1906 and 1907, with losses on the cotton alone of $550,000 and $800,000. These losses are met and distributed through insurance, but that does not solve the problem. The loss falls nevertheless heavily upon the country's resources.

Upon investigating locomotive spark fires one is impressed by the lack of authoritative statistics as to such fires and amount of damage compiled by the Interstate Commerce Commission, State Railroad Commissions or other public officials dealing with the railroad problem. The office of the Ohio State Fire Marshal has taken the lead in this as in many things. That office has recorded the locomotive spark losses during the past ten years, and during the past four years the amount of such losses and the insurance. Spark losses are reported in each month of the year, and at the ratio of loss for the four years the 1,161 fires recorded in the ten years' period would amount to $1,295,676, and these statistics do not cover the crop and woodland fires of the country. With these results where the buildings are well constructed, business conservatively managed, and the fire loss ratio of the state one of the lowest, what must be the figures not compiled in the newer and frame constructed districts of states farther west?

That the spark danger is increasing is evident from the loss record of insurance companies and the attention now being given to the subject in the legislatures. The available evidence also indicates it. *The Forester* of Wisconsin has reported that from 1904 to 1907 the railroads set 4 to 6 per cent of the fires; in 1908, 15 per cent, and in 1910, 20 per cent. The Interstate Commerce Commission reports for 1900 to 1909 inclusive an

increase of 20,514 locomotives or 54 per cent. These locomotives are of course of larger sizes and greater coal consumers, as the average size of locomotives has been increased. The experts of the U. S. Geological Survey have stated that the railroads consumed ninety million tons of coal last year, ten per cent of which, or nine million tons, was thrown unconsumed out of the locomotive stacks. On this basis the Smoke Inspector of Chicago has estimated that 14 car loads of cinders are discharged daily out of the locomotive stacks within the city limits.

Such is the problem of the locomotive spark. Public officials, particularly foresters, recognize the danger and are trying to enforce conditions to eliminate the hazard. The courts constantly have such cases for loss claims on their calendars and the legislatures are being appealed to for laws which will better protect the citizens from the burdens which the railroads evade. Where buildings are endangered the inclination is to look to fire insurance for protection. But the intelligent now realize that insurance merely distributes the burden over the many and in no way remedies the trouble. In fact insurance protection too frequently induces indifference on the part of both the property owner and railroad as to the security of the property from fires. The remedy is public education, as it is with all other hazards. The extent of spark fires will not be realized until official investigations are made, for which the state fire marshals are probably the best equipped. Judging from past history, the trouble will not be recognized or corrected by the railroads until public attention is given to the problem. The fire marshals or railroad commissions should be authorized to place where it properly belongs the financial responsibility for fire losses occasioned by railroad negligence or operation.

The Hazards of Ferrosilicon.

By J. A. Robinson.

In Europe and England there have been several instances of violent explosions during the handling of closed casks containing ferrosilicon, the cause of which was attributed to the evolution of an inflammable and poisonous gas, and heat generated by friction between lumps of ferrosilicon. Frequent attention has been drawn to the poisonous effects of the gases evolved from this substance when it is carried in other than air-tight cases, which have repeatedly caused illness and death among crews and passengers in vessels. So far as known, no fatal accidents, either by explosion or poisoning, have occurred in this country. Our engineering and technical journals have brought this matter before the public and some underwriters have become interested, making inquiries as to the truth of these assertions and the probabilities of a new hazard being introduced in this country. This paper is written with the desire to make the matter clear, and to allay any unwarranted fears.

Ferrosilicon is an alloy of iron and silicon, now produced in the electric furnace by the combination of these materials in varying proportions, to meet certain conditions. It is classified according to the percentage of silicon present, this percentage varying from the "low grade," containing not more than 15 per cent, to that known as "high grade," containing up to 96 per cent of silicon. The greatest output appears to be of the 50 per cent grade, which is the grade most practicable commercially when the combined properties,—specific gravity, melting point, calorific value, percentage of impurities and ease of calculation, are considered. As will be shown later, it is this grade which has proved most hazardous. Ferrosilicon looks like a metal, varying in color from an iron gray in the low grades to a silver or steel-blue-gray in the higher grades. In the extreme grades the mass is close, but in the intermediate grades the texture is coarser, sometimes exhibiting bubble cavities. Its principal characteristic is the variations of hardness and of specific gravity of the alloys containing different percentages; which may serve as a rough indication of the approximate composition. The specific gravity and consequent weight decreases as the percentage of silicon increases, which obviously follows from the fact that the specific gravity of pure iron is 7.8 while that of pure silicon is 2.49.

Ferrosilicon is used in steel making in a manner similar to spiegeleisen or ferro-manganese. If certain quantities are added to the molten steel, it aids the mass to remain liquid for a sufficient length of time, by the oxidation heat of silicon, to permit thin and intricate castings to be made. It also helps in preventing the formation of blow-holes, acting as a reducing agent and removing undesired impurities, and it has an important influence on many of the physical properties of steel. During the past few years it has been used to quite a large extent in the manufacture of special steels containing relatively high percentages of silicon; for example, in the manufacture of "non-aging" transformer steel. Silicon has always been used for a specific purpose in the manufacture of cast iron, and ferrosilicon has been found a convenient form in which to introduce it into the iron.

The British Local Government Board, through a committee of eminent English experts, conducted an exhaustive research on the manufacture, uses and transport of ferrosilicon, which forms a report issued as a "Yellow Book." In France a commission of French manufacturers made a very careful investigation, issuing their report shortly after that of the British Board, and corroborating it in every essential. An examination of the technical literature of Germany, France, England and the United States relative to this subject has been made. The center of the industry in this country, at Niagara Falls, was also visited, and the leading electro-metallurgical experts consulted. Based on the information thus gained the following facts pertinent to the purpose of this article are offered.

Up to a few years ago ferrosilicon came largely from a number of

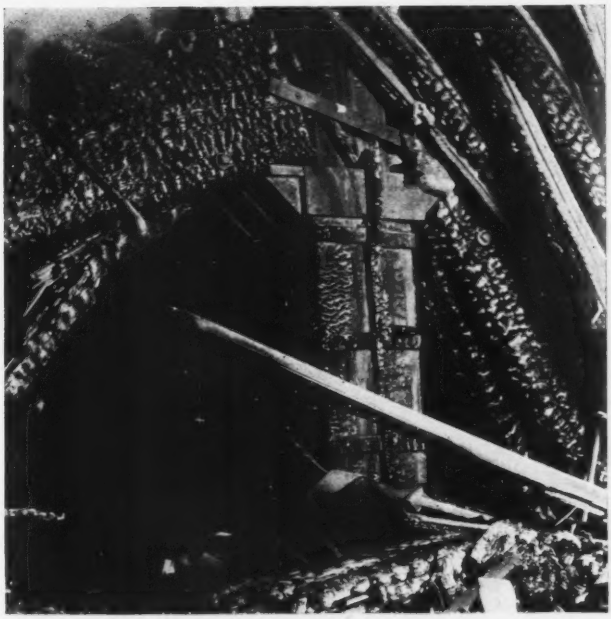
mountain electric furnace plants, notably in southern France, which had originally been erected for calcium carbide manufacture, but had to go into some other line when the European carbide boom collapsed. Electric resistance furnaces are used for the manufacture of ferrosilicon. The details of these furnaces and their operation need not be discussed, but the nature of the charge is an important consideration. The charge consists of definite proportions of (1) steel shavings and scrap iron, (2) anthracite coal, charcoal or coke, (3) siliceous material in the form of quartzite or sand. The French silica generally contains an appreciable amount of calcium phosphate and arsenate; the steel contains traces of phosphorus; and the carbonaceous materials contain other impurities. Calcium phosphate is reduced in the electric furnace, in the presence of carbon, to calcium phosphide. This in contact with water or moist air is decomposed with the evolution of the inflammable evil smelling and intensely poisonous phosphoretted hydrogen or "phosphine." Calcium arsenide is formed and gives off arseniuretted hydrogen in the same manner. Iron was formerly used, but owing to the high phosphorous and sulphur content it has been abandoned. The addition of lime as a flux has also been abandoned. The amount of these gases given off by different grades of ferrosilicon depends not only on the impurities present in the materials used in the electric furnaces, but also on the physical properties of the alloys. In consequence of this, in certain cases, access of moisture is afforded to a much larger extent of surface, notably in those approximating the 50 per cent grade, having the coarse texture previously mentioned. The grades of ferrosilicon containing from 42 to 60 per cent show a distinct tendency to spontaneous disintegration. They crumble on keeping, and some of them actually fall to powder after the lapse of a few weeks or months. This is accompanied usually by the evolution of the gases before mentioned. In the other grades, both lower and higher, there is an absence of any tendency to disintegrate spontaneously. Probably the lack of serious trouble in this country from the imported ferrosilicon is explained by the fact that the gases would be completely dispersed before its arrival. The trouble abroad was partly attributed to the fact that owing to the demand the material was packed and shipped as soon as made. It was customary at one time to immerse the ferrosilicon, while still hot from the furnace, in a bath of kerosene oil or melted paraffin, but this did not prove very successful and invoked the danger of sealing up the gas, so to speak, to be let loose at some future date in the factory where it might be used. In view of these facts, regulations were made by the English Board of Trade to obviate, as far as possible, the chance of further accident during the transport of this substance and its care after receipt. The majority of French manufacturers have agreed on making only certain grades, which are said to be free from danger. Let us consider the conditions in this country.

Although this country is the pioneer in the manufacture of most electric furnace alloys, ferrosilicon was developed abroad and not made

here until within a few years, at which time a considerable quantity was being imported into this country. Steel manufacturers were quick to realize the advantages of the high grade electric furnace alloy, the use of which (in spite of its high price) compared favorably with low grade blast furnace ferrosilicon. The manufacture offered good profits. A large company was formed with plants in Niagara Falls, N. Y., and in West Virginia, also a company in Lockport, N. Y., one in Welland, Ont., and others elsewhere. A company making metallic silicon was formed and some sprung up making other and competing alloys of iron. Overproduction soon resulted, and the prices of ferrosilicon were practically cut in half. At the present time most of the French works are operating on a largely reduced scale, and none of their product is being imported into this country. The weakest of our producers went to the wall, and the Electro-Metallurgical Company now supplies a very large proportion of the product used in this country to-day. Great care is constantly taken by them and considerable additional expense involved in the selection and use of all the raw materials employed, in order to insure the production of an alloy which does not possess these objectionable properties. The margin is said to be very close and little prospect of any great future development of this industry. As this company makes a product that is said to be free from the impurities and consequent dangers of the product hitherto found on the market, the reason for this economic review now becomes apparent.

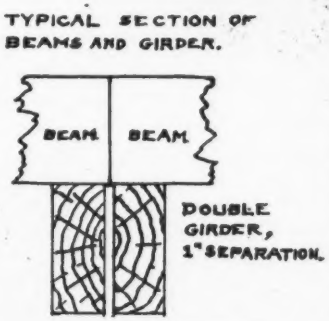
In view of the facts thus obtained and the apparent condition of the industry at present, there need be little apprehension of the presence of a hazard in the shipment or use of ferrosilicon, nor is it probable that such will arise in the future.

Acknowledgments are made to assistance received from *Metallurgical and Chemical Engineering; The Engineer* (London); *La Lumiere Electrique;* Frederick M. Becket, Metallurgist, and others.



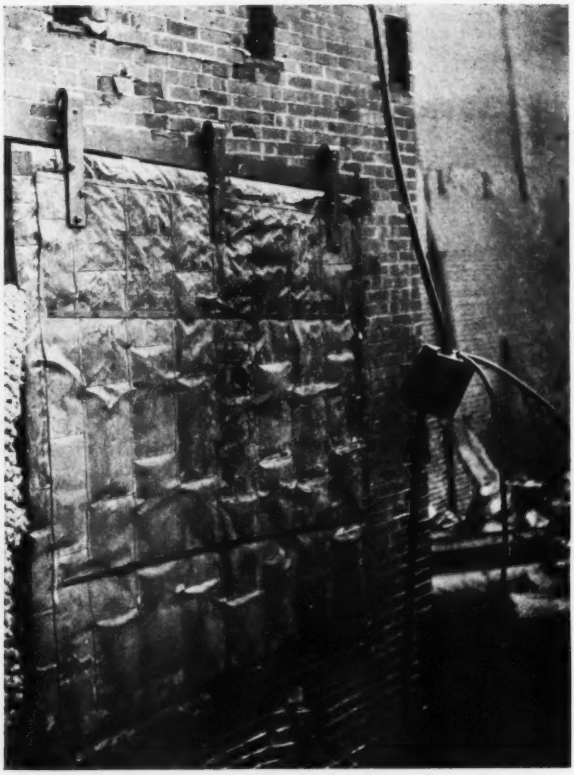
Fire H-6282. Mill Construction Paper Warehouse.
Showing collapsed double beams.

Double Beams and Fire.



Undesirable Construction.

In certain buildings of mill construction, carrying stocks of excessive weight, it has been a common practice to make the main beams of two pieces of timber side by side, bolted together. An air space between the pieces was formerly advocated in behalf of better seasoning and possible avoidance of dry rot. Experience has demonstrated, however, that this space not only reduces the resistance of the beams to fire by offering almost double the wooden surface to its attack, but that in case of fire getting started the space between the beams holds it for a long time and prevents its extinction. The accompanying photograph shows a collapse of such double beams, which are not so severely burned but they might have held had they been one solid timber, or had the two pieces been bolted tightly together. It is obvious that neither automatic sprinklers nor ordinary hose-streams can successfully reach fire lurking in such narrow alleys. Such construction should be avoided.



A Standard Fire Door.

In a large paper warehouse in which everything in one section was destroyed by fire, a line of standard tin-clad fire doors effectively protected all stories of the adjoining section. The accompanying photograph shows one of the doors. Self-releasing timbers saved the walls from wreck, and the doors kept the fire in the burning section. Note the integrity of the standard hardware and the unwarped body of the door, due to its well-selected lumber and proper nailing. Nothing happened to it but the bite the fire took out of the core exposed in the little round gas-vent.

The Automobile as a Fire Hazard.

By N. B. Pope.

That part of the old scandal that suggested a tendency to go to pieces, like the deacon's "one-hoss shay," has been successfully disproved, but there are a few timorous souls who still believe that the average automobile is liable to blow up most any time. In this connection it is unfortunate that such things do happen occasionally under certain aggravated conditions, and this circumstance, coupled with the fact that wherever cars are garaged it is necessary to store and handle considerable quantities of gasolene, oils and other inflammable materials, lends a certain serious aspect to the matter. That there is a certain amount of fire risk attendant upon the storage and operation of cars is a fact that most automobile men, accustomed to taking proper precautions, are perhaps too much inclined to make light of. Such risk as there is may be said to be increasing, not in the sense that greater menace is involved in the modern car, but in the sense that the number of cars in use is increasing and that each year the number of heedless, incompetent and unscientific operators is increasing. By reason of the fact that it uses a highly inflammable form of liquid fuel, the gasolene automobile commonly is saddled with a greater nominal risk than is rightfully its own. To remove this impression would be a profitable undertaking in many ways; it would strengthen the confidence of the public in the motor vehicle; it would be of material benefit in convincing the manufacturer and merchant of the advantages of motor transportation as an adjunct to his business, and it would tend to avoid and eliminate unjust discrimination between this and other transportation mediums.

So far the question does not appear to concern the automobile engineer in the least, but a moment's reflection will show that he is concerned. He is obviously responsible for the original construction of the automobile, and if it is possible in any way to alter or amend its properties so as to render it less liable to originate fires than it is at present, or less a menace when contained in a burning building than it now is, it would seem that it is not only a matter of concern, but of duty for him to give the problem due attention. As to the operation of existing vehicles, it is a point not yet generally appreciated that in the broad field of maintenance, as in manufacture, there is ample opportunity for the employment of engineering talent. There is need for the analytical ability and knowledge of the trained engineer in the design and construction of garages and garage

appliances, in the development of garage systems, the installation of equipments and the supervision of operations. This is true of the housing and maintenance of pleasure vehicles, but where the commercial vehicle is involved the engineer becomes indispensable. The protection of garages and operating equipments against fire losses thus becomes a very worthy problem for the engineer to consider. Already a great deal has been accomplished in this connection. The average modern, well-equipped garage is so constructed, arranged and outfitted as to be as safe, relatively speaking, as could be desired. Unfortunately this is not true of the average garage the country round. Many such establishments have been converted from other uses, many have been built hastily and without due regard to certain definite precautions that should be embodied in every garage that may properly be called safe. With such establishments the engineer who is in any way in touch with installation and operation work well may concern himself. It is unquestionable that many of them are positively dangerous, not only as pecuniary risks, but in material degree as a menace to the reputation of the industry.

The principles of safety in garage construction are so well known that they need only to be touched upon very lightly in this connection. They include the imperative need of fireproof building construction, constant and effective ventilation of all floors, thorough drainage embodying well-ventilated settling chambers to prevent the accumulation of volatile oils and inflammable supplies, underground fuel tanks and, wherever possible, provision for dispensing fuel and oils in the open air or at least in an isolated court or passage which is subject to thorough ventilation at or about the ground line. In many localities most of these requirements already are taken care of by municipal or insurance regulations. But where the engineer is concerned with getting a certain amount of work out of an equipment at a minimum cost it behooves him to see that no fire loss is involved. In too many instances overmuch dependence is placed on rules and regulations in connection with the care and handling of cars. But rules are the weakest sort of safeguard imaginable, because they depend entirely on the human equation. The garage risk is twofold. It involves the possible risk arising from the storage and handling of large quantities of oil. It also involves a certain amount of risk due to the housing of a large or small number of cars, each of which may be considered in itself a risk. In an ill-ventilated garage a spark from the unprotected controller of an electric car, the arcing of a switch at a charging board, a stray spark from the ignition system of a gasolene car, a back-fire or a muffler explosion may cause a fire through the ignition of stagnant gasolene vapor or gas.

Likewise, there is a very slight possibility of fire in the woodwork of an electric vehicle, due to some derangement of circuits, while the gasolene car presents certain very lively possibilities in this direction. Not only may cars of this type become the source of fires, but their tank-loads of fuel become, in the minds of the public and of firemen who may be called upon

to handle a blaze, so many charged bombs ready to scatter burning gasolene in every direction. That in many known instances cars have been badly scorched and even partially burned without sufficient pressure being generated in their tanks to cause them to burst is a peculiar circumstance that, while comforting in itself, is not to be depended on as a precedent. It is my desire particularly to call attention to the fact that the very circumstance that every motor vehicle carries a certain amount of stored energy in itself constitutes what may be termed a potential risk and to emphasize the importance of safeguarding the public and the industry against future losses from this source. Considering the exact nature of the hazard — that is to say, the number of cars in use to-day, which has been placed at not far from 400,000 in this country, and the amount of energy which they daily consume — it is a high compliment to the industry that the actual risk is no greater than it is. It is unquestionable, however, that whatever risk exists to-day can be materially reduced in the individual machine by careful forethought in design and assemblage. Scrutinized in detail probably the average car of modern construction would seem at first to be as safe as it can be made; doubtless this would be true were it always to be handled in a careful manner. Unfortunately, however, the average driver is to be considered in all his moods and in every state of mind and body in which he may undertake to handle the machine. The pleasure car is subject to the abuse of thoughtless, reckless and often of intoxicated operators; the commercial car is destined to be cared for by men of more cautious temperament, as a rule, but less alert and intelligent. Neither type of machine can be overlooked in attempting to reduce to a minimum the fire risk. Incidentally, a factor that must be considered in connection with the latter type is that not only the vehicle itself, but its load of merchandise as well, is involved in any risk of which the vehicle partakes. Therefore, the commercial car that is absolutely free from fire risk — and I believe it perfectly practicable to construct one — should prove an attractive proposition to market.

The problem of fire risk as involving the individual machine may be considered under two general headings: First, the power plant, and, second, the general vehicle structure. Under the first heading electric and gasolene equipments may be discussed independently. Considering, then, the power element of the electric vehicle, it is apparent that there are but two possible sources of risk, namely, the electric spark and the overheated wire. Sparks may occur at the controller, at the motor or from crossed wires or short-circuits caused by disarrangement of the wiring or connection. The liability of burn-outs, either in the motor or in the connection is small, though burned-out motors are by no means unknown to electric vehicle history. Equally simple are the protective measures that are available. All controller and motor mechanisms should be iron-clad and the controller, at least, asbestos-lagged if its construction is such as to render it at all liable to arcing at the contacts. All conductors, whether on battery, motor or bell and lighting circuits, should be thoroughly protected against

chafing and disarrangement and all outside connections should be protected in suitable junction boxes. While both the iron-clad method of arrangement and the use of lead-sheathed conductors are expensive, the permanence of either alternative, combined with the immunity from injury which it insures to the conductors, should sanction the use of one or the other on all carefully constructed cars. For motor connections lead-sheathed flexible conductors are preferable to the more common circular-loom protection.

In the case of the gasolene machine the risk is more involved, first, because the power plant itself contains greater elements of danger, and, second, because the presence of considerable quantities of gasolene and oil increases the liability of a fire spreading regardless of its origin. The gasolene car risk may be divided into primary and secondary elements. Considered in order the elements of direct risk are: 1. Fuel tank. 2. Fuel piping. 3. Carbureter. 4. Exhaust piping and muffler. Any one of these elements may become a direct hazard as a result of poor construction, careless handling and accident. Secondary elements of risk, or those which in conjunction with one or more of the direct elements may lead to a fire in the car itself, are: 1. Ignition system. 2. General arrangement.

Just as "crossed wires" are blamed for a majority of buildings' fires of otherwise unexplained origin, so "explosion of gasolene" is the cause assigned to most automobile fires. But the automobile engineer must seek further in order to arrive at a proper means of preventing loss. In the first place, gasolene, in the ordinary acceptance of the word, does not explode. Indeed, those who have become thoroughly familiar with its properties through carbureter experiments know that even its vapor is reluctant to ignite save under the most propitious circumstances. Therefore, the chief danger in connection with the gasolene tank and piping is leakage, as this is the principal cause of trouble where fuel tankage and piping are involved in a fire. As a means of preventing leaks the tank must be of such strength and so mounted that it will not be strained by the working of the car, while the piping should be so arranged that it will yield to frame distortion without injury to the couplings. These precautions already are taken satisfactorily in most cars, though it is possible that the use of copper or tin-lined steel tanks of sufficient strength to resist considerable internal pressure would inspire confidence in the safety of the car with respect to the danger of the bursting of the tank in the event of a fire. There is no question that the air inlet to gravity tanks should be protected by a gauze screen as a means of preventing the ignition of the free gas within the tank, while pressure tanks might be provided with a blow-out plug mounted over a screened orifice as a means of preventing an explosion and providing an outlet for the fuel vapor during a fire.

As a special means of precaution it is possible to conceive of an emergency shut-off for the carbureter feed pipe, spring actuated and ordinarily held open by a plug of fusible metal. Such an arrangement could be so constructed that it would close the gasolene line automatically should the

contents of the carbureter take fire. With suitable measures to prevent carbureter fires, however, this would seem uncalled for. But it is particularly important that the regular gasolene shut-off from the tank be so located that it may be reached in an emergency without difficulty or delay, and, furthermore, that it be so conspicuously arranged that it can be manipulated by one not otherwise familiar with the mechanism of the car — even at some risk of unlicensed tampering. The average carbureter may be innocent enough of any menace in the way of setting fire to the machine, but it is well known that it lies well within the means of the average motorist to produce a mixture that will back-fire, and back-fires occasionally furnish heat enough to vaporize the contents of the float chamber. As gauze screens not only will prevent the passage of flame beyond a given point, but, in the opinion of many engineers, are helpful in carrying out the atomizing of the charge and the dissemination of heat through it, it is difficult to see why the average carbureter is not provided with screens already.

Certainly designers who object to obstructing intake pipes with wire mesh should have no compunctions about screening the outer air passages, and such screens would prevent the issuance of flame even were the contents of the mixing chamber to take fire, at least until the flames could be put out either by racing the engine or shutting off the air. Combined with the occasional tendency to back-fire, probably the greatest source of danger in the average carbureter is leakage arising from improper adjustment. As this cannot be forestalled by the designer, the only thing left for him to do is to provide a separate drip for the carbureter outside the sod pan. The importance of making this provision cannot be too strongly emphasized and it can be asserted confidently that this simple precaution, coupled with the arrangement of all gasolene feed piping outside the pan, will do more to avoid loss in individual fires than almost any other step that can be taken in the drafting room. The exhaust side of the motor is commonly regarded as being free from danger in respect to fires, but it is not absolutely so. Improperly made joints and gaskets, blown out by explosions in the exhaust manifold and piping, are liable to cause the ignition of any stray vapors, as may the bursting of the muffler. Therefore, it is important that provision be made for tight joints and amply strong construction.

The ignition system has been mentioned as a secondary element of risk. It becomes so only when so constituted that a stray spark at the timer may serve to ignite inflammable vapors which may have collected under an improperly ventilated hood. Under the broad head of general construction may be considered, first, the arrangement of the motor with respect to inflammable material; second, the question of lubrication as a contributory cause, and, third, ventilation. Commonly speaking, there is little fault to be found with the mounting of the engine in regard to the proximity of woodwork. But it is possible to find many instances in which too little attention has been paid to the risk that is involved in this

way. Oil-soaked and blistered dashers and floor boards are by no means uncommon, and while the writer does not know of a single instance in which a fire has been started from an overheated exhaust pipe, the readiness with which such conditions would lend themselves to a fire once started may be held to explain the rapid consumption of some cars that have been burned to the ground in a very few minutes. Plainly it is important to employ metal construction for the engine compartment, particularly where the motor is housed under the seat or beneath the floor boards, as in some of the lighter forms of commercial vehicle, and to be liberal in the use of asbestos-lagging where it is necessary to bring hot metal close to dry wood. As far as lubrication is concerned it may be considered that the presence of waste oil in the sod pan, on the outside of the cylinders and crank-case and on the interior of the engine compartment, adds to the risk, though not tending to incite conflagration. The modern forms of self-contained engine oiling system are models in this respect, and it may be assumed that as time goes on general cleanliness about the engine will increase. It is important that in laying out a power plant there shall be no unventilated pockets where oil or gasolene can collect to contribute to the risk.

Turning from the power plant to the general construction of the vehicle, but more particularly the body, conditions are much the same as in any other medium of transportation. It is possible, for example, to build a perfectly fireproof body; such bodies are now being built on chassis designed for the transportation of money and securities. The all-metal body would not only have its advantages in this respect, but there is much to be said in its favor from the point of view of economy, and it is by no means a rash prediction that it will be commonly, if not generally, adopted in commercial vehicle construction in the not far-distant future. Certainly all body parts which are close to heated metal, or such as might become inflammable if saturated with oil, should be, if not of metal construction, at least metal-sheathed. One other question which arises in this connection is that of illumination. It is commonly considered that no great risk is involved, even in the use of kerosene lamps, and probably the only instance in which the lamps have been in any way concerned with the starting of automobile fires has been in cases where a detached lamp has been used as a searchlight by some short-sighted Diogenes of the car in search of an honest leak. It is beyond question, however, that the more general adoption of electric lighting on cars, even on those of the commercial type, will be of assistance in reducing the nominal risk of fire.

Meeting of Executive Committee.

The Executives of the Association met on June 7, 1911, in Chicago, the following being present:—

W. H. Merrill, President, Chicago.
F. J. T. Stewart, Chairman, New York.
Franklin H. Wentworth, Secretary-Treasurer, Boston.
George W. Cleveland, Cincinnati
C. M. Goddard, Boston.
C. A. Hexamer, Philadelphia.
H. C. Henley, St. Louis.
W. E. Mallalieu, New York.
W. G. Sanderson, Chicago.
W. S. Wensley, New York.
L. Wiederhold, Jr., Philadelphia.

Consideration was given to the following items referred to the committee by the Association at the annual meeting:—

1. The propriety of recommending to the Laboratories a revision of the statement that wired glass is suitable for moderate exposures only.

VOTED: That Chairman of Executive Committee be requested to confer with Chairman of Committee on Fire Protection Coverings for Window and Door Openings on this subject, and report result of conference to the Executive Committee.

2. Reports of committees on Fire Prevention Ordinances, Automobile Garages and Theatre Construction.

VOTED: To refer the reports of these three committees, together with a transcript of the minutes of the annual meeting, to a sub-committee of the Executive Committee, of which the Chairman of the Executive Committee shall be Chairman, and of which he shall appoint the other members.

The following matters were also referred to this sub-committee:—

(*a*) Consideration of advisability of including in ordinances specifications for ventilation of motion picture booths.

(*b*) Consideration of advisability of specifying the size of tanks for water supply in theatre sprinkler protection, as incorporated in report of Committee on Theatre Construction, the suggestion of the Executive Committee being that any ordinance to be useful must be specific, and that the reputation of the Association requires that all specifications put out by it be correct and defensible.

The following sub-committee was appointed: Chairman, F. J. T. Stewart, C. M. Goddard, W. E. Mallalieu.

3. VOTED: That a committee be appointed on Private Fire Departments and Fire Drills to revise the Association's present pamphlet on that

subject, with suitable additions from Mr. Newbern's paper presented at annual meeting, and other available sources.

4. VOTED: That all published pamphlets of the Committee of Consulting Engineers of the National Board of Fire Underwriters, not under process of revision, be adopted as the standards of the Association.

5. VOTED: That the report of the Committee on Signaling Systems, as amended, be approved and its publication as a standard be recommended to the National Board of Fire Underwriters.

6. *Re* recommendations of Committee on Standard Hose Couplings and Hydrant Fittings:–

VOTED: (*a*) To recommend to N. B. F. U. republication, in size uniform with other pamphlets, of pamphlet giving specifications and drawings for National Standard Hose Couplings and Hydrant Fittings, with addition of any advisory suggestions of which the officers of the Association may approve, but excluding matter contained in any other pamphlet.

(*b*) That the Secretary correspond with active members maintaining inspection departments in relation to the purchase by them of thread-pitch gauges for inspectors' use in reporting dimensions of couplings, after the committee shall have furnished prices on such sets of gauges.

(*c*) (On motion of Mr. Henley, a member of the committee) That the matter of free distribution of thread-pitch gauges to chiefs of fire departments be laid upon the table pending the Committee's quotation of the cost of the same.

IT WAS UNANIMOUSLY RESOLVED: That the Association discontinue the practice of examining individual devices and materials and confine itself to the formulation of standards for such devices and materials, and that in conformance with this resolution the Devices and Materials Committee be discontinued.

COMMUNICATION from South Eastern Underwriters' Assn., active member, *re* gasolene-engine-driven fire pumps, was referred to Committee on Fire Pumps.

IT WAS RESOLVED: That no individual should be asked to serve on more than three committees: and the nomination of committees for the fiscal year was referred to the officers with power, with the request that this resolution be observed, if practicable.

As instructed by the Association at its annual meeting, the President appointed the following committee to co-operate with the officers in revising the Articles of Association:—

C. M. Goddard, Chairman, Boston.
R. L. Humphrey, Philadelphia.
A. W. Hadrill, Montreal.
R. D. Kohn, New York.
C. E. Meek, New York.

It was VOTED: That the sixteenth annual meeting be held in Chicago, May 14, 15 and 16, 1912.

Do It For Rochester!

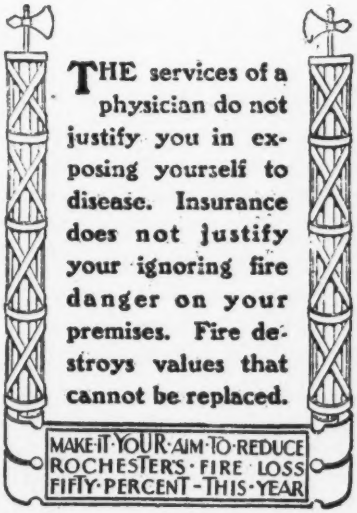
Our Associate member the Rochester Chamber of Commerce has evolved a plan of local fire prevention campaign astonishingly simple, but obviously effective.

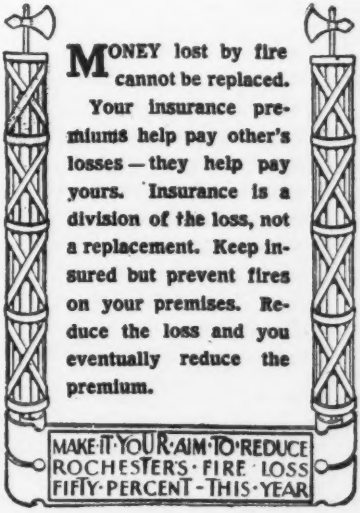
A well-edited pamphlet or well-considered speech or address has its peculiar use; but where the public is concerned, iteration and reiteration of scraps of good counsel is the most fruitful method of propaganda.

The Rochester Chamber supplies unmounted plates of brief, terse sentences to the newspapers and requests their use wherever they have a blank space at column-ends or elsewhere; in fact to keep them handy to the forms and drop them in whenever they have a chance. The matter is changed frequently to prevent staleness, and it works out that most of the papers run it every day.

The most noteworthy fact in connection with this plan is that the press is glad to co-operate in the good work and donates the blocks of 3-inch space free of charge.

Here are samples of these little plates used in June:


THE services of a physician do not justify you in exposing yourself to disease. Insurance does not justify your ignoring fire danger on your premises. Fire destroys values that cannot be replaced.
MAKE IT YOUR AIM TO REDUCE ROCHESTER'S FIRE LOSS FIFTY PERCENT - THIS YEAR


MONEY lost by fire cannot be replaced. Your insurance premiums help pay other's losses — they help pay yours. Insurance is a division of the loss, not a replacement. Keep insured but prevent fires on your premises. Reduce the loss and you eventually reduce the premium.
MAKE IT YOUR AIM TO REDUCE ROCHESTER'S FIRE LOSS FIFTY PERCENT - THIS YEAR

Worcester, Mass.: Oxy-Acetylene generator after explosion, showing generator intact except top and clockwork blown off. Carbide cans at right were used to hold residue. Hopper from interior of generator in foreground.

Explosion of Acetylene Gas Generator

Supplying Oxy-Acetylene Welding Apparatus

(*Special Report.*)

On the afternoon of June 8, 1911, an explosion occurred at the Worcester Welding Company, Worcester, Mass., in a 50-pound automatic Davis-Bournonville pressure generator manufactured by the Davis Acetylene Company, Elkhart, Ind. This generator was housed in a reinforced concrete building 7 x 9 x 8 feet. This building had a galvanized iron roof and was situated twenty-one feet from the nearest buildings. The concrete walls constructed of angle iron with steel lath were about two and one-half inches thick. As a result of the explosion these walls were laid flat, not being carried more than eight feet from their original location. The corrugated iron roof was carried to the west a considerable distance, and the cover of the generator was carried to the east over a small building, a distance of seventy-five feet. The greatest damage was done by the metal-covered wooden door of the building, which was thrown against the piazza post of a frame house twenty-one feet away, in such manner as to cause the piazza to collapse and spring the rear end of the house, necessitating considerable repairs. Windows were broken in

many directions, but there was no serious damage other than that mentioned. No one was hurt, and no fire was caused by the explosion.

The explosion of an oxy-acetylene generator derives its especial interest at this time from the fact that the process of welding and cutting by means of the combination of oxygen and acetylene is comparatively new in this country, although of extended use in Europe. A combination of oxygen and acetylene when ignited at the tip of an oxy-acetylene torch produces a flame said to possess the highest temperature known to chemistry, approximately 6,300 degrees F. The use of this flame in the metal working industries promises to be extensive and the oxy-acetylene welding apparatus is rapidly growing in popularity. This being the case, a careful analysis of the hazards connected with its operation becomes of particular value at this time.

The use of the oxy-acetylene blow-pipe in the United States has a history of less than four years. The rapidity of the introduction of the process demonstrated the necessity of adequate rules and regulations governing the installation and use of its apparatus, as in the case of systems of generating acetylene gas for house illumination. The Rules and Requirements of the National Board of Fire Underwriters for the Construction, Installation and Use of Oxy-Acetylene Heating and Welding Apparatus, were published late in 1910. In the meantime a large number of oxy-acetylene generators had come into use, which did not comply in detail with the new rules and requirements. The generator which exploded in Worcester belonged to a type manufactured and tentatively permitted prior to the adoption of the rules, and other models now put out by the Davis Acetylene Company differ in many particulars from the one which exploded in Worcester, and have been tested after examination by the Underwriters' Laboratories.

The place of the explosion was visited by Mr. E. L. Sanders, representing the N. F. P. A., Mr. G. L. Smith, representing the Factory Mutual Insurance Companies, Mr. J. M. Morehead, B. S. E. E., representing the Union Carbide Company, and Mr. A. Cressey Morrison, Secretary of the International Acetylene Association. Mr. Geo. C. Neal, Deputy Chief Massachusetts District Police, also made a personal inspection.

In order that the cause of the explosion may be understood it is necessary to state something of the nature of calcium carbide and acetylene. Calcium carbide consists of calcium and carbon chemically united by means of the electric furnace. The carbide itself will neither burn nor explode; nor is it affected by concussion in any way. It may be subjected to any temperature less than that of the electric furnace without any material change in its character. When, however, it is brought into contact with water, the affinity of the calcium for the oxygen in the water manifests itself and the carbon is released to join the hydrogen, forming

the hydro-carbon acetylene, a gas of extreme richness. The residue is inert and consists simply of slacked lime.

The method of generation in the case of the generator which exploded is to drop the carbide by means of a clockwork mechanism, regulated automatically, into a large volume of water, the resulting gas accumulating in the generator until a pressure of about eight pounds, with a limit of fifteen pounds, is reached. Acetylene acts like any ordinary gas in all particulars save one. Other gases in ordinary use can be compressed to liquefaction without changing their nature in any respect. Acetylene, however, when compressed to approximately two atmospheres, acquires properties which it loses again when the pressure is withdrawn. Acetylene under atmospheric pressure, without an admixture of air or oxygen, will not ignite or explode, even with the application of the electric spark. When, however, acetylene under atmospheric pressure is subjected to a high temperature, the molecules in contact with the hot surface polymerize into other substances, and if the temperature is high enough, into the original elements of hydrogen and carbon. This change is, however, local, and may go on indefinitely; so that acetylene in the presence of a hot surface is not dangerous until by compression to approximately two atmospheres the molecules are brought sufficiently close together so that the disassociation of one is transmitted to the other. When this point is reached all the acetylene under pressure will disassociate with explosive violence.

The problem, therefore, to be solved in the case of the pressure generator for oxy-acetylene purposes is to provide a safety device which will strictly limit the pressure to the standard, which is fifteen pounds to the square inch. This fifteen pounds to the square inch leaves a large margin of safety. Reliable safety valves are already available and have proved themselves dependable in connection with oxy-acetylene apparatus. Generators limited to a pressure of fifteen pounds to the square inch should be as safe from disassociation as the house generator with its ounce or two of pressure has proved itself to be. In the case of the house generator, there is no record of an internal explosion without an air mixture. The house generator has withstood exposure by fire without losing its gas, and without any explosion from the heat. In the case of the generator in Worcester, the generator itself is intact and water tight. When first examined, it was found that it still contained a quantity of water, together with the residue. The generator itself is not distorted in any way. The steel cover of the generator on which the clockwork was located was, however, torn off, severing twenty-four half-inch bolts. The cover is crimped at one point, indicating that one bolt gave way, followed by a tearing action on the others. The clockwork of the generator has not been recovered, and it is presumed that it was carried off by children. The fact that the cover, with its heavy bolts, was torn from the top indicates clearly that the internal pressure in the generator did not rise slowly; for had it done so, other parts of the machine less strong

Worcester, Mass.: Oxy-Acetylene generator after explosion, showing condition of corrugated iron roof. Buildings and fence uninjured except for some broken glass. Building not shown had piazza damaged by heavy fire door striking it. No fire was caused by explosion.

would have yielded first. All the indications point to a disassociation of the gas, which struck so violent and sudden a blow upon the cover that it tore it from its fastening, while the water below protected, by its inertia, the bottom of the generator, which normally should have yielded first. It appears that the explosion had its inception in the carbide hopper and this protected the sides of the generator above the water, although this point, of course, could not be definitely ascertained. The machine had been used during the forenoon and had been recharged prior to the noon hour, when it was put out of operation. Shortly after one o'clock the machine was put in operation again, and the blow-pipes made ready for use, and some gas was drawn off. The blow-pipes were not in use when the machine exploded, and had not been for sometime. It is probable there was considerable after-generation, and it is probable that the machine fed considerable carbide immediately prior to the shutting off of the blow-pipes. The carbide was fresh when put into the generator, and as it was taken from the bottom of a drum, it probably contained considerable fine carbide. The machine having been used during the morning, probably slowly cooled, and the water of condensation undoubtedly attacked the carbide, adding somewhat to the generation of

gas. The indications of probable after-generation under the methods of use by the Worcester Welding Company are shown by the fact that a locking device attached to the safety valve, which will be mentioned later, had on several previous occasions operated, showing that the safety valve had acted on previous occasions. There was apparently no escape of gas into the building, or explosion outside the generator. The cause of the disaster was the rise of pressure above the point of disassociation of acetylene in the interior of the generator, accompanied by a rise of temperature in the carbide, owing to the water of condensation, or to some drops of water falling upon the carbide in such a manner as to raise the temperature locally above the point where disassociation in the acetylene takes place. The failure of the safety valve which permitted this rise in pressure is responsible for the trouble. It has been ascertained that the blow-off pipe to which the safety valve is attached would be entirely capable of carrying off the acetylene as fast as the clockwork could produce it, without an undue rise in pressure. Therefore, the question resolves itself into the construction of this particular safety valve.

The safety valve was an aluminum disc seated upon a soft rubber ring. The disc was about one inch in diameter and the aperture in the rubber ring was a little over one-half inch. This disc was attached to a valve stem which carried a rawhide diaphragm. The inside dimensions of the diaphragm were about three inches. Underneath the diaphragm was a metal disc designed to support it, and above an extension of the valve stem which held the diaphragm in place. The annular space between the disc holding the diaphragm and the outer edge of the cast-iron case was slightly over one-fourth inch. The soft rubber ring on which the safety valve disc rested was of such a character that it would follow the disc for a short distance when the safety valve moved to release the gas. The rawhide had been subjected to the action of the lime dust which was carried by the unpurified acetylene and had hardened. In addition to this combination which belongs to the safety valve proper, a series of levers had been attached to the safety valve containing nine moving joints which were designed to shut off the clockwork as an emergency stop when the safety valve moved to release the excess of pressure. The sticking or displacement of any of these moving joints would cause the safety valve to fail to operate, and the use of rawhide under the circumstances may in itself have interfered with its operation. The following of the safety valve disc by the rubber on which it rested may also have caused trouble. It is impossible to state exactly what happened except that the safety valve certainly failed to work. There was a consequent rise in pressure and it happened probably at the same time there was a piece of hot carbide in contact with the acetylene. Following the law of its nature, the compressed acetylene disassociated, with the results recorded. Future explosions of the same character should be avoidable by the selection of a safety valve which will operate and which will not

deteriorate, and which may not be used as a device to operate other mechanisms. A double protection might be afforded by two valves, one a check upon the other, attached to separate openings in the shell of the machine. The explosion in Worcester would seem to have no other significance than the demonstration of the imperfect character of the safety valve in use on that particular machine. From that point forward the laws of nature were followed out in exact accord with the known facts. The adopted standard of fifteen pounds to the square inch as the limit of practical safety in the use of acetylene pressure generators allows an ample margin of safety. The provision of an adequate and satisfactory device to limit this pressure, one which will operate under all conditions, is the lesson to be drawn from the Worcester explosion.

Automobile Garages.

The number of fires (126) in automobile garages of which a record is given in this issue is, of course, but a very small percentage of the total number of fires occurring in such properties during the five or six years in which automobiles have become a factor in American civilization. The causes of the fires as given are, however, sufficiently diversified to indicate the subtile nature of the hazards wherever gasolene is present. The general impression prevalent among fire protection engineers seems to be that the private garage has not proven to be as bad a hazard as was expected, but that the public garage has proven a great deal worse. It may be that in the long run private garages may not have a worse record than stables, with their hay, straw and alley accumulations.

It is sufficiently obvious from reading the record that garages, both public and private, should have no place in buildings with other occupancies, or in fact in any buildings not especially constructed for such use. Their special hazards must be definitely counted on and prepared for in their equipment, and in cities where their location constitutes an exposing menace to adjacent buildings, they should be frequently inspected by municipal officers.

In all the five boroughs of greater New York there are now about two thousand garages, private and public, and inspectors of the Bureau of Combustibles recently discovered in them nine hundred and seventy violations of the regulations governing their operation—in some instances a dozen or more violations in one establishment; cases of greasy floors, open containers of gasolene, open furnaces and forges and defective electric wiring. The wonder is that under such conditions many disastrous fires have not already resulted in New York from garage practices—and

especially when it is considered that the recent shocking fire tragedy at Nantucket was caused by the careless combination of a burning match and a recently oiled floor.

Many city garages are open day and night, and the employees in them and the "hangers-on" of the premises are not commonly a class of persons any too careful about the disposition of burning matches, hot cigar ashes and cigar and cigarette stubs.

As to fires in the automobile itself, such for example as the frequent carbureter fire, caused by the engine "back-firing" and igniting the gasolene at the carbureter, these may be expected to decrease in number as perfection in manufacture is attained. Many manufacturers have already given attention to reducing this particular hazard, although certain makes of machines are still well known offenders in this direction, and it is a point that should be inquired into by careful purchasers.

Given a perfectly constructed machine with reference to the fire hazard, there still must remain the permanent menace of its volatile and inflammable fuel, reaching out its thin, silent, deadly, vaporous fingers toward the lamp, the forge, the electric spark, or that cheerful idiot with a lighted cigar or match whom modern eugenics has not yet bred out of the race.

Automobile Garages—Fire Record.

Total Number of Fires, 126.

1. CLASSIFICATION OF CAUSES.

Common Causes.

LIGHTING. Number of fires, 1.

Fire was caused by defective electric wiring. Room was occupied for painting, and owner had stretched a canvas below the sprinklers to protect automobiles from dust and dirt. Fire spread to the canvas and flashing over ceiling opened sixty-eight sprinklers. Sprinklers practically extinguished fire; small loss.

HEATING. Number of fires, 4.

Portable kerosene oil heater was upset or knocked from workbench, causing fire.

Fire caused from overheated stoves, 2 fires.

Fire originated from overheated furnace.

POWER. Number of fires, 0.

BOILER (or fuel). Number of fires, 0.

RUBBISH (or sweepings). Number of fires, 3.

Spontaneous ignition of rubbish and sweepings that had been placed in wooden boxes and barrels.

Fire originated in a barrel of rubbish. Undoubtedly painters who had been working in building threw some oily rags into same.

Fire from spontaneous ignition of rubbish occurred in the basement and spread up through partition and pipe boxing to roof, burning through ceiling and igniting tops of automobiles stored there.

OILY MATERIAL. Number of fires, 6.

Fire was caused by spontaneous ignition of oily rags. Automobile had been cleaned with gasolene the day before and the oil and gasolene saturated rags left lying on the floor.

Owner cleaned automobile and left the oil and gasolene saturated rag on workbench. Later one of the employees threw his overalls over this waste, which ignited spontaneously shortly after.

Fire was caused by spontaneous combustion of oily waste under an auto which was being repaired.

Spontaneous ignition of oily waste kept in locker or tool box of cars, 2 fires.

Fire was caused by spontaneous ignition of oily waste.

SMOKING. Number of fires, 4.

Cigar stub was carelessly thrown into some combustible material which spread fire to cans of gasolene and oils, and to automobiles.

Employee smoked cigarette while repairing automobile.

Employee smoking while cleaning automobile.

Fire caused by smoking occurred in rear end of an automobile in storage.

LIGHTNING. Number of fires, 0.

LOCOMOTIVE SPARKS. Number of fires, 1.

MISCELLANEOUS. Number of fires, 1.

Employee attempted to thaw a frozen water pipe with a gasolene torch and ignited combustible material nearby.

Special Hazard Causes.

GASOLENE OR BENZINE CLEANING. Number of fires, 14.

Chauffeur placed a new spark plug in machine and then went to front of car to clean engine. Explosion occurred from unknown cause, igniting car and building. Building was two stories high, of frame construction, first floor occupied for a private garage, the second floor for dwelling purposes. Building and contents were practically destroyed.

Automobile had just been cleaned with gasolene. In attempting to start the engine, gasolene vapors ignited, presumably from ignition

system, setting fire to automobile. Automobile was in the yard and the flames were confined to machine, which was destroyed.

Employee was cleaning the upholstery on an automobile, using gasolene from a small open can, when the gasolene ignited from unknown cause, causing a slight explosion. No fire resulted, although upholstery of car was considerably damaged. Automobile was located on the third floor of main building. Fire emphasizes the hazard of gasolene cleaning and the use of gasolene from other than safety cans.

Employee was repairing and cleaning the commutator on one of the busses. He started to test the engine before putting the cover on commutator. When the engine was turned over, a spark in the commutator ignited the gasolene vapor which had accumulated around the engine. Building was one story in height, of brick construction, with concrete floor. Building and automobiles were a total loss, estimated at $20,000.

Employee lighted lamps on automobile and threw lighted match into a pan of gasolene nearby with which he had been cleaning the automobile.

Fire occurred in a one-story private garage. Employee was cleaning car with gasolene when the vapors ignited from a small gas stove, fire flashing through the medium of the vapor to the car. Car was pushed into yard and fire extinguished by fire department.

Carbureter was being cleaned and a small amount of gasolene leaked onto floor. A portable electric light without guard was being used and was laid on the floor near the spilled gasolene. Either a spark or heat from the lamp was sufficient to ignite the gasolene vapors.

Building was one story high, of brick construction and occupied as a private garage. At the time of fire, two men were working in the garage, one cleaning automobile with gasolene, the other using a blow torch about fifteen feet from the machine. Gasolene vapors ignited at the blow torch, fire flashing to the automobile, immediately enveloping it. Automobile was pushed from the building, where fire was extinguished by fire department. The east and west walls of the building were partially wrecked by the force of the explosion. Loss $2,000 on automobile.

Fire occurred in the garage on the third floor of the four-story and basement brick mercantile building. Employee was cleaning machine, using gasolene from an open can. Vapors ignited at wash rack, flashing back and causing explosion at can. Loss approximately $60,000.

Fire was caused by the ignition of benzine from unknown cause while

used for cleaning. There were several people present at the time and it is thought that possibly someone was smoking. Garage contained eighteen or twenty cars at time of fire which were safely removed, as the car being cleaned was located at the back of garage. This car, however, was badly damaged. Loss $6,000.

Employee was cleaning engine with gasolene at the time fire occurred, using a portable electric lamp. Lamp was accidentally broken. The hot filament and arcing ignited the gasolene vapors, fire flashing to container. Loss $22,000.

Fire occurred while employees were repairing and cleaning an automobile. It is thought that a short circuit occurred on the engine which ignited the gasolene vapors present. Fire immediately flashed to the oily concrete floor, spreading so rapidly that the two men working on the car were unable to check it. Loss approximately $13,000. Building was of frame construction with cement floor.

Fire occurred while cleaning the engine of a car with benzine from an open vessel. The car had been damaged by fire on the road and was located at the entrance of the garage at the time fire occurred. A bystander looking on struck a match to light a cigarette and threw the same near the open vessel of benzine. Vessel was pulled out onto the sidewalk and car was only slightly scorched.

Private garage was of brick construction, one story high, and contained one car on which employee was working at the time of explosion. Gasolene and water were used in cleaning the car and it is evident that these collected in the pit under the car, the vapors from the gasolene being retained in the pit which when ignited from unknown cause resulted in a terrific explosion. The roof and front wall of the garage were demolished and employee was seriously injured.

AUTOMOBILE REPAIRING. Number of fires, 6.

Building was occupied as a garage and by various other tenants. Fire occurred at 3 a. m., the garage operating night and day. After finishing work for the night, two employees brought their own machine into garage and commenced working on it, using a torch under the machine. Gasolene ignited from the torch and partly destroyed the machine. Fire was extinguished with sand and chemical extinguishers before sprinklers opened.

Fire occurred in an automobile in garage at 4 p. m. Car was being repaired and in some way leaking gasolene was ignited.

Fire occurred at 3.15 p. m. in a brick building occupied as an automobile garage. A gasolene blow torch, used in repairing, was overturned in some way, causing a slight blaze. Fire was extinguished before fire department arrived.

Building was of frame construction, occupied as a garage and contained three automobiles at the time of fire. The gasolene pipe leading from supply tank to carbureter became clogged in some way. In cleaning out the obstruction, owner found it necessary to cut into pipe and afterwards attempted to solder the break with a gasolene blow torch without taking the precaution to see that all gasolene had been removed from the car. Explosion resulted, igniting car, and as same was standing in front of the only door of garage, owner was able to escape only by breaking through the frame wall of building, narrowly escaping serious injury.

Fire occurred in an oven used for baking enamel on small automobile parts. The odor of burning enamel attracted the attention of employee who saw fire in oven through the thermometer opening in the door. At the time fire occurred, oven was being used to dry some automobile parts, on which there was no enamel. The oven was heated by gas, the temperature ranging from two hundred to three hundred degrees. Burners were protected from enamel drippings by sheet iron guard pans, and it is thought that the enamel drippings on these pans were ignited by the heat. The oven and contents were ruined.

Fire was caused by the spontaneous ignition of oily paint rags in painting room.

FILLING GASOLENE SUPPLY TANKS OF AUTOMOBILES.

Number of fires, 12.

Fire occurred at 9.48 a. m. on the first floor of public garage. Side walls of first floor were sheathed and painted, and ceiling was sheathed and varnished. Fire was caused by an outsider lighting a cigarette and throwing the lighted match onto floor while employee was filling the tank of an automobile close by. Fire resulted, practically destroying building and causing a total loss on contents. Loss $70,000.

Garage was one story high, of frame construction, concrete floor on earth, and gravel roof. Area one hundred feet by fifty feet, height twenty-five feet. Building contained about twenty-five cars at time of fire. Fire was caused in the following manner:—

A car containing a party of four called at the garage for a supply of gasolene. The car was run into the garage without the people getting out or extinguishing the head and tail lights. While pouring gasolene into tank, tank overflowed, the vapors igniting at the lamps, flashing and setting fire to the car. Fire destroyed the car and spread to all parts of the building. Loss large.

Fire occurred at night in front of the garage. Owners of the automobile were filling the reservoir with gasolene with all lights burning.

There was also a man standing nearby smoking. Gasolene vapors ignited from the open lights, destroying the automobile and setting fire to the building, also spreading to a barn nearby. Loss large.

Garage was two stories high with cement floor first, second floor and roof semi-mill construction. First floor, on which fire occurred, was occupied for storage, washing and filling of cars with gasolene. Fire occurred from unknown cause while employee was filling automobile with gasolene. He was using a five-gallon open top can, pouring the gasolene through a strainer funnel into tank. He had just emptied the can when the gasolene ignited from some unknown cause. It is probable that employee either stepped on an unburnt match or that there were lighted automobile lamps on cars on the same floor. Fire was extinguished by approved chemical fire extinguishers before fire department arrived. Loss $300.

Fire occurred in a frame shed addition to garage. Owner was filling storage tank of automobile when vapors ignited from a lighted lantern several feet distant on the opposite side of the room. Gasolene was forced into shed by compressed air through a pipe from outside underground storage tank. Loss $3,500.

Building was of semi-mill construction, heavy beams on wooden girders supported by wooden posts. Occupancy as follows: First floor, automobile livery, auto sales and display; second floor, manufacture of batteries and battery charging. Fire occurred from unknown cause at 8 a. m. in the premises of the auto livery. Employee was filling the storage tank of an automobile from Bowser pump. Pump and auto were located in the rear on the first floor, and from appearances after the fire, fire started at this point. There was an open stairway near this section of the building from the basement to the second floor, through which fire spread to other floors. Nineteen automobiles were badly damaged before fire was extinguished, and beams and posts were charred to about a quarter inch depth throughout first and second floors. Loss large.

Garage was of joist construction supported on post foundation, ironclad and without sheathing. Fire was caused through the attempt to fill gasolene supply tank of automobile while the engine of car was running. Gasolene vapors were ignited, setting fire to automobile. Car was inside of garage at the time, and building and contents were a total loss with the exception of one automobile which was rolled out. Loss $15,000.

Fire occurred at 5.45 p. m. on the first floor of building occupied as garage and repair shop, caused by employee attempting to fill gasolene supply tank of automobile before engine had cooled. When he started to pour gasolene into tank, flames burst from under the machine, igniting the car.

Building was one story high, of brick construction, and occupied as a private garage, and contained three automobiles at time of fire. Employee was pouring gasolene into the tank of a car when some of the gasolene was spilled onto the floor. Vapor was carried by the draught to an open fire where it ignited, flashing back to the can. Employee dropped the can, which allowed the burning gasolene to run over the floor. The three cars were set on fire and before the fire could be checked the cars were ruined and the building gutted. Loss $15,000.

Fire occurred at 8.13 a. m. in the one-story brick, wooden roofed garage. Roof was without ventilators. Employee evidently stepped on match while filling gasolene supply tank of motor cycle. Loss $23,500. The fire loss was greatly increased by not sending in fire alarm until the fire had burst through roof, by the low roof without ventilators, low partitions, oils stored near gasolene pump, floors in repair shop not being kept clean, and no private fire protection.

Building was of modern brick and joist construction, three stories high without basement, and with a one-story addition in rear. First floor of cement construction with a metal ceiling, and occupied as a garage with repair shop in the rear one-story addition. Second floor occupied for pool and billiard rooms; third floor, offices. The gasolene supply tank of garage was located outside of the building, gasolene being supplied to cars by a pump. Pump was located in the repair shop near the brick wall. It was the intention of the owner to protect the opening between repair shop and storage with fire doors, but these had never been installed, and greatly increased the fire loss when fire occurred. Fire occurred at 11 p. m. A man came into garage with his motor cycle for a supply of gasolene. Supply tank was filled too full and overflowed onto the hot engine of motor cycle and ignited. The man in his fright ran with the burning machine through the storage section, spreading burning gasolene over the floor. Thirteen automobiles were consumed before fire was extinguished. Loss considerable, with but slight loss on building. Had fire doors been installed on opening from storage to repair shop, fire would have been confined to repair shop with but slight loss.

Fire occurred at 2.35 p. m. in the garage on the first floor of the four-story semi-mill constructed building. Building was equipped with a modern system of automatic sprinklers. Fire occurred from the explosion of gasolene in a pail attached to a pump, from which the gasolene was being drawn to fill reservoir of automobiles. The cause of the explosion is unknown.

The sprinkler system was shut off at the time fire occurred, as the insurance patrolmen were replacing sprinkler heads which had been opened by fire occurring a short while before. Water was turned

onto system with but short delay. This, however, was sufficient to cause forty-three heads to open, which extinguished the fire.

The intensity and rapidity with which fire spread is shown by the charred condition of the ceiling, beams and girders, which were severely charred to a depth of about a sixteenth of an inch. Loss $5,336.

CARBURETER FIRES. (Caused by engine back-firing and igniting gasolene at carbureter.) Number of fires, 9.

Building in which fire occurred was occupied in the basement and first story as a garage with a stock of automobiles and supplies; second, third and fourth floors as an apartment house.

Fire occurred in the garage at 11 p. m. A Pullman six-cylinder automobile had just been run into the basement and the engine was left running for a few minutes. The chauffeur then turned the switch controlling the battery circuit, cutting off the sparking. This created a back draught at carbureter, fire flashing through the inlet pipe, igniting the gasolene in the carbureter and forcing gasolene out onto the floor. Fire spread to paper which had been placed on car tops, and cars were badly damaged.

Fire occurred on the first floor of private garage, second floor of which was occupied as a dwelling. Fire was caused by back-firing which ignited gasolene at carbureter. Car had been in use several seasons and all parts underneath the body were heavily coated with grease and oil, causing fire to rapidly spread over entire automobile. The bottom of gasolene tank soon melted off, greatly increasing the intensity of the fire. Loss $9,200.

Fire occurred in a small frame private garage, occupied on first floor as garage, and on second floor as dwelling for the chauffeur. Chauffeur was cranking engine when an explosion occurred from back-firing, causing a flash fire at carbureter which ignited the car. Car and building were destroyed. Loss $6,000.

Fire occurred in private garage. Back-firing of engine had occurred several times and chauffeur was working around machine trying to remedy it. When he cranked engine again, back-firing ignited the gasolene which had leaked onto apron under car. Building and contents were badly damaged by the resulting fire before the arrival of firemen. Loss $2,800.

Fire occurred in private garage, caused by the back-firing of engine.

Fire occurred in a small detached frame building used as a garage.

Gasolene from leaky carbureter was ignited while cranking engine. Private garage was of brick construction and one story high. Fire

occurred while cranking engine, a back-fire igniting the gasolene at carbureter.

Building was of brick construction, one and two stories high, occupied as a private garage and dwelling. Fire was caused by the ignition of gasolene from leaky carbureter by back-firing while cranking engine.

Public garage. Building was one and one and a half stories high, of ordinary brick and joist construction, with a twenty car storage capacity on the first floor and a small amount of storage on the second; gasolene supply tank was buried outside.

Fire, occurring in the front of the first floor, was caused by the ignition of gasolene at a leaky carbureter. Employee was starting a car when the engine back-fired, igniting the leaking gasolene. Flames flashed to the floor, where about half a gallon of gasolene had leaked unnoticed and then rapidly spread from car to car, enveloping the entire first floor. Fire also spread to the second floor through an unprotected frame enclosed stairway on the outside of the building. Two chemical extinguishers were used at the start of fire, but without success. Fire was extinguished by public fire department. Loss $34,000.

GASOLENE FIRES. Number of fires, 17.

The building in which fire occurred was occupied as an automobile store and repair shop, and was of brick and joist construction. The salesroom was located on first floor and repair shop on second. Fire was caused by the ignition of a sixty-gallon can of gasolene on the first floor from unknown cause.

Building was one story high with brick walls, not sheathed, plank floor, open mill construction roof with monitor. Section in which fire occurred was about forty by one hundred and fifty feet and occupied as a public garage. The definite cause of fire is unknown. Watchman and employee who were on duty state that fire flashed all over floor almost as soon as discovered and it is probable that vapor from gasolene was either ignited from a defective lamp cord or from stepping on a match. Loss $12,500.

Fire occurred on first floor occupied as a garage and repair shop. First floor was of open joist construction. Fire was caused by an employee who spilled some gasolene from an open can near heating stove, gasolene vapors immediately igniting from the stove.

Fire occurred in the office of the garage located in a brick open joist constructed building. Employee filled a glass bottle with gasolene at Bowser pump located outside of garage. He then brought bottle into office. In attempting to tightly cork the bottle, it crushed in his

hands, the vapors igniting from a gas stove burning nearby. Fire was extinguished with but slight loss with two chemical extinguishers.

Fire was caused by gasolene; cause not given.

Building in which fire occurred was three stories high, of brick construction, formerly occupied as a stable but at the time of fire for storage and care of automobiles. Fire occurred at 6.15 during the preparation of a car for service. The boy assisting struck a match to look under car and ignited some gasolene which had collected on the grease apron under car. Automobile was situated so that it could not easily be moved and fire rapidly spread to other cars nearby. By the time fire department arrived, several cars were in flames, and the heat, flashes of fire and fear of explosion, prevented the firemen from entering the building. About twenty-six cars were destroyed or badly damaged. The interior of building, and roof also, was badly burned. Loss $13,493.

Gasolene fire from unknown cause badly damaged garage and automobiles. Loss $8,800.

Building in which fire occurred was occupied for a public garage and repair shop. Building was one story high, forty-five by eighty feet in area, of frame construction with wooden sheathed walls and open ceiling. Roof was board on joists covered with two-ply proprietary roofing. This roof resisted the fire admirably and held the roof intact, although the boards were badly burned below the roofing.

The walls were covered on the outside by three-ply asbestos paper, which was burned away in some places near the top of the walls. The wooden sheathing on the inside of the walls was badly burned, although most of it remained in place and prevented the flames from acting directly upon the outside boarding and asbestos sheathing.

Fire was discovered at 5.30 p. m. on the floor under an automobile which had just been run into the wash room for washing. Fire was probably caused by a leakage of gasolene from the automobile. Employee took a pail of sand and threw it onto the fire, which seemed to sweep the flames from in under the car towards the rear of the car. Flames then spread to the auto top, in which there was a thin sheet of celluloid for a window. This was ignited and fire rapidly spread to other cars and woodwork. The fire lasted about half an hour, burning out the main automobile storage room and repair shop. Loss about $54,000. Fire was extinguished by public fire department.

Fire occurred at 9 a. m. in the two-story frame garage, caused by a person stepping on a match which ignited gasolene vapors. Fire destroyed building and four automobiles, badly damaging three two-story buildings and severely exposing five three-story brick buildings nearby.

A 200-gallon gasolene storage tank exploding from unknown cause at 8 p. m. caused the destruction of the garage.

Fire occurred in public garage at 2.27 a. m. Vapors from leaking gasolene from an automobile were ignited by an open light. Loss approximately $40,000.

Building was three stories in height and occupied as follows: First floor, automobile salesroom; second, school for motoring; third, printers. Fire occurred on the first floor at 11.50 p. m., caused by the ignition of gasolene vapors from a leaky tank on an auto truck. Loss large.

Fire occurred on the first floor of three-story frame building occupied as a garage. Vapors from gasolene leaking from tank on automobile were ignited from unknown cause, probably from a cigar. Car was pushed from the building and fire extinguished by chemical fire extinguishers.

Employee was smoking from fifteen to twenty feet from where gasolene was being poured into the underground storage tank from ten-gallon cans. He threw match onto ground, which ignited vapors, flashing fire and igniting two cans of gasolene which had not been emptied. Filling-opening to storage tank was located outside of garage in a frame metal-clad addition.

The soldered seams in the two cans soon melted and the burning gasolene flowed under the sill of the garage. Sand pails and eight chemical extinguishers were used and fire practically extinguished before the arrival of fire department. Woodwork was only slightly charred.

Fire occurred in private garage and repair shop, caused by an explosion of gasolene vapor under an automobile delivery truck. Cause of ignition of vapor unknown.

First floor of private garage was of concrete construction and contained a cleaning pit. Second floor was occupied as a dwelling for chauffeur. Fire occurred from the ignition of vapors from leaking gasolene at 10 p. m. Car had just returned from repair shop and two men were working putting it in complete order. Man in the pit was using a portable electric lamp equipped with guard. At the time of fire, lamp was lying on the floor beside the pit, when, without warning, a burst of flame drove the man from the pit and immediately after the gasolene supply tank of automobile exploded.

Fire was undoubtedly caused by a spark in the wiring or socket of electric lamp igniting the gasolene vapors, fire flashing through the vapor to the leak in the gasolene supply tank. Fire was extinguished by the city fire department with a loss of $35,000.

Garage was of brick and joist construction with composition roof. Fire occurred while employee was drawing a five-gallon can of gasolene. Either someone struck a match igniting the gasolene vapors, or they ignited at a vulcanizer about ten feet from gasolene pump. Garage and contents were totally destroyed.

FIRES OF UNKNOWN CAUSE OCCURRING IN AUTOMOBILES. Number of fires, 8.

A new automobile standing in the center of the garage floor was discovered to be on fire. Cause of fire is unknown. It is stated that a repairer was using a gasolene blow torch while repairing an automobile nearby and it is possible that gasolene was leaking from the automobile and the vapors ignited at blow torch and flashed fire to the car.

Fire occurred in the automobile from unknown cause at 1.09 a. m. Car was in a private one-story frame garage. Loss $11,834.

Building in which fire occurred was occupied by two firms, an automobile repair shop and automobile garage. These were separated from each other only by wire mesh and frame partitions. Fire occurred at 5.50 a. m., from unknown cause under an automobile in the garage. This caused an explosion of the gasolene in the car, fire rapidly spreading throughout building. Loss $68,000.

Fire from unknown cause originated in the battery box of an automobile. It is supposed that wires short circuited, igniting gasolene vapors present, or that oily waste might have been stored in the box and ignited spontaneously. Loss $4,200.

Fire occurred in the drip pan of automobile from unknown cause. Sand and blankets were used, extinguishing fire without loss.

Fire occurred from unknown cause in an automobile in public garage at 5 a. m. Garage was constructed with brick walls and wooden gravel-covered roof, carried on iron girders. Fire was extinguished by fire department with a loss of $44,000.

Fire occurred from unknown cause in an automobile which had been run in and left on the first floor of public garage a few minutes before fire broke out. Fire was discovered at about 2.30 a. m. by one of the employees of the garage. Two employees started with pails of water to extinguish the fire, but were unable to cope with the blaze. Before alarm could be given, the gasolene tank under the car exploded, scattering burning oil in all directions, only one of the employees being able to escape.

Fire rapidly spread through the brick elevator shaft to the top floor, causing considerable damage to the roof and slight damage to other floors. Loss estimated at $150,000.

Fire started from unknown cause in a car which had been standing ready for service for several hours. The car burst into flames without apparent cause and within a few minutes the entire floor was a mass of flames.

Public garage was of brick and joist construction, three stories and basement in height, with blank side walls. Floors were of wood on wooden joists and covered with cement; side walls and ceilings were sheathed with wood.

Fire rapidly spread throughout building through an open elevator shaft and well hole, also by overhanging bay window on the second floor. The wooden sheathing on side walls and ceilings greatly added to the spread and intensity of the fire. The contents of the first floor, consisting of ten automobiles, were completely destroyed. The offices and supply rooms on second floor were burned out and there was also slight damage on the third floor.

Garage was equipped with a good supply of chemical extinguishers which could not be used on account of the rapid spread of fire. Fire was extinguished by fire department with a loss of $34,000.

FIRES OCCURRING IN ELECTRIC AUTOMOBILES. Number of fires, 2.

Fire occurred on the first floor, occupied as a public garage; second floor occupied as a vest factory.

At 2.45 a. m. night workmen discovered an electric automobile situated near the entrance door to be on fire. It is thought that the wiring of machine was defective and that short circuit caused ignition. Fire rapidly spread to a gasolene machine standing near. The soldered gasolene tank soon melted and the escaping gasolene rapidly spread fire throughout first floor. The location of the burning machines prevented the removal of other machines, and twenty-nine automobiles were destroyed. Fire was extinguished by fire department. Building was not badly burned and fire was held in check and prevented from spreading to second floor. Loss large.

Fire occurred in the storage room of public garage, containing at time of fire two empty gasolene automobiles and seven electric machines. A short circuit in one of the electric machines caused fire.

TIRE VULCANIZING. Number of fires, 3.

Fire was caused by explosion of vulcanizer in the repair shop of garage. The cause of the explosion is unknown. Loss small.

Public garage was located in about the center of the block of frame and brick buildings, severely exposing two three-story brick buildings on the right, and stores on the left. Garage was one story, of brick and wooden construction, and was divided into four sections on the street front by frame and brick partitions with unprotected open-

ings—occupied as follows: Restaurant, shooting gallery, entrance to garage and office, real estate office.

Fire was discovered at 2.40 a. m. in the rear of the garage by an outsider who gave the fire alarm. Fire is thought to have originated at the vulcanizer from the location of same and the severe burning at this point. Upon arrival of fire department fire was severely exposing the three-story brick building on the right through window openings provided with fire shutters which were open at the time of fire. Fire department prevented fire from entering the building and confined same to the garage. Loss approximately $6,000.

Building was one story, of frame construction, with wooden floors and occupied for a garage with vulcanizing and repairing. Fire occurred at 11 a. m. at the vulcanizing machine. Workman allowed gasolene to overflow the cup for heating burner. When he struck a match to light burner, vapor from the gasolene on floor ignited, causing a severe flash fire, fatally burning workman. Building and two automobiles were totally destroyed. Loss $10,500.

Summary.

Common Causes.

	No. of Fires	Per Cent of Whole
Lighting	1	1.1
Heating	4	4.4
Power	0	.0
Boiler (or fuel)	0	.0
Rubbish (or sweepings)	3	3.3
Oily material	6	6.7
Smoking	4	4.4
Lightning	0	.0
Locomotive sparks	0	.0
Miscellaneous	1	1.1
Total	19	

Special Hazard Causes.

	No. of Fires.	Per Cent of Whole.
Gasolene or benzine cleaning	14	15.6
Repairing	6	6.7
Filling gasolene supply tanks	12	13.3
Carbureter fires	9	10.0
Gasolene fires	17	18.9
Automobile fires, cause unknown, in gasolene automobiles	8	8.9
Electric automobile fires	2	2.2
Tire vulcanizing	3	3.3
Total	71	

	No. of Fires.	Per Cent of Whole.
Common Causes	19	21
Special Hazard Causes	71	79
Total	90	
Incendiary	1	
Exposure	2	
Cause Unknown Fires	33	
Total Automobile Garage Fires	126	

2. ROOMS IN WHICH FIRE OCCURRED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Office	..	..	1	2	1	6	2	3
Stock room	..	..	..	..	2	13	2	3
Car storage	7	50	40	83	7	44	54	69
Repairing	6	43	6	13	4	25	16	21
Painting	1	7	1	2	..	..	2	3
Oil storage	..	..	..	..	2	13	2	3
Total with data given	14		48		16		78	
No data	5		23		20		48	
Total	19		71		36		126	

3. DAY OR NIGHT FIRES. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	6	33	33	55	7	21	46	41
Night	12	67	27	45	27	79	66	59
Total with data given	18		60		34		112	
No data	1		11		2		14	
Total	19		71		36		126	

4. PLANT IN OPERATION.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in operation .	10	67	51	87	9	37	70	71
Plant not in operation	5	33	8	13	15	63	28	29
Total with data given	15		59		24		98	
No data	4		12		12		28	
Total	19		71		36		126	

5. HOW DISCOVERED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent
Employee	10	53	56	88	11	37	77	68
Watchman	1	5	4	6	4	13	9	8
Thermostat	..	..	..	..	..	..	..	..
Sprinkler Alarm .	..	..	..	..	..	..	..	..
Outsider	8	42	4	6	15	50	27	24
Total with data given	19		64		30		113	
No data	..		7		6		13	
Total	19		71		36		126	

6. POINTS OF INTEREST FROM FIRE REPORTS.

Alarm Service.

H-5614. Fire was discovered by the watchman, who tried to extinguish it with a hose stream. Failing in this, he gave alarm and disappeared.

Construction.

H-1879. The wooden cornice and unprotected windows on the adjacent two-story brick building were easily ignited by the exposure spreading fire into the building.

H-2471. Garage was one story and basement in height, with brick walls which were open in basement but lathed and plastered in first story. Partitions in first story were lath and plaster on wood studding. There was also a three-foot concealed space in the ceiling. Fire started in the

basement, spreading through concealed space of walls and partitions into roof, where it burned through ceiling and ignited the tops of automobiles stored on first floor.

H-4347. Building was of concrete block construction, blocks twelve inches thick with a four-inch air space. Mixture of concrete was one part cement, two parts sand and three parts crushed stone. Blocks were severely exposed by fire and subjected to water from hose streams. The concrete blocks stood up well, not being injured or calcining to any appreciable extent.

H-5017. Garage was constructed of hollow concrete blocks, which were for a short time subjected to a hot fire with only superficial damage to a few of them.

Dry Powder Extinguishers.

H-5611. Fire occurred near gasolene pump. Dry powder extinguishers were used with but little effect on fire. Had a supply of approved chemical extinguishers been at hand, fire could have been extinguished without the assistance of fire department.

Fire Wall.

H-4754. A parapetted fire wall between garage and adjoining building, with all openings protected by standard fire doors, confined fire to the garage.

Floor Openings.

H-3242. Elevator was enclosed in brick walls, with swinging tin-clad fire doors at openings. Employees had used elevator to move an automobile just before fire and had left the fire door open on third floor. Fire followed this open flue from first to third floor and to roof.

H-3595. There were open stairways from basement to first floor and from first floor to second. Also an open elevator shaft from basement to second floor. Fire rapidly spread through these openings, enveloping building.

Public Protection.

H-4347. Fire department was seriously delayed upon reaching building on account of hydrant cap sticking. It was nearly ten minutes before water could be secured and hose streams used.

H-5155. Fire occurred in a garage located in what was considered the extra hazardous section of the city, the garage exposing lumber yards and other frame buildings. Fire assumed conflagration proportions almost at once. A neighboring city was called upon for help, but was unable to render aid as the thread on hose couplings was different. Fire burned for twelve hours before being extinguished.

Fire-Resistive Buildings---Fire Record.

These fires are selected to illustrate the behavior of various forms of fire-resistive construction under exposure to fire from within or without.

H-6461. April 28, 1911. Sugar Refinery. Construction of Building. The refinery building, in which the fire occurred, is a nine story and basement building of steel and cast-iron skeleton construction, of area about 20,700 square feet. The walls are of brick, independent, curtain 16–12.

There are a few partitions of wood on first, second and third and one of six-inch terra cotta with wood doors on ninth. Floors are single, of two-inch maple, laid on wood sleepers imbedded in cinder concrete having a minimum depth of three inches, on six-inch segmental terra cotta arches on steel I beams and girders on cast-iron columns. Span of arches is five feet. The webs of beams and girders are protected by the floor arches, and their lower flanges are fireproofed by a lip on the terra cotta skewbacks and a shoe tile two inches thick. The columns are protected by four inches of brick, apparently laid in lime mortar. Ceilings and walls have open finish, whitewash only. The principal floor openings are two stairs of iron with slate treads, without supporting steel web plates, open through all floors. There are likewise two open elevators, and numerous openings for pipes, conveyors, etc., necessitated by parts of the process of manufacture, perhaps the worst of which were the large wooden sugar bins on the fifth, extending through the floor into the sixth story.

Occupancy. The floors through which the fire burned, *i. e.*, the fourth, fifth, sixth, seventh and eighth were occupied as follows:—

Fourth: Loaf sugar dryers; packing; storage of loaf sugar in barrels. Fifth: Sugar bins, granulators and pulverizers. Sixth: Sugar bins, conveyors, granulators and dust collector. Seventh: Centrifugals; employees' lockers. Eighth: Setting tanks; storage of sugar in barrels. Ninth: Vacuum pans, vacuum pumps, condensors; salt water tanks; sweet liquor tanks.

The lower floors were used for storage of sugar in bags and barrels, not skidded, sugar bags in bales, laboratories, offices, engine and dynamo rooms, and were subject to water damage only.

The mixing of the sugar was carried on in a separate building across the street. The char house is the adjoining building to the west, in the basement of which are located the retorts for reburning the bone black. This building is cut off from that in which the fire occurred by a fire wall having three-ply sliding fire door on one side of wall at openings, and

swinging on the other. The doors themselves are well made and fit the openings closely, but hardware is not standard. There were no automatic attachments, but the doors were kept closed. The doors withstood the excessive heat of the fire, and effectively prevented it from spreading to the other building.

Fire Protection. Two four-inch standpipes located at stairs with 100 feet of two and one-half inch linen hose on each floor, supplied by 750-gallon Underwriters automatic fire pump. Service pumps are also connected to standpipe.

Alarm Service. Switch on each floor of building, to be set in case of fire, rings bell in basement, and engineer turns in fire alarm, also opens valve connecting service pumps to standpipes. A notice was posted on each floor reading as follows: "In case of fire, raise lever, uncoil hose and open valve."

Cause and Spread of Fire. Cause not definitely determined, but the fire is supposed to have been due either to a spark from the blowers connected with the granulated sugar dryers and the dust house on roof, or from an explosion of dust in one of the pulverizers on fifth floor. The pulverizers did not connect with the dust house, but connected with a dust collector on sixth floor. It is stated that the top of one of the pulverizers was blown off.

Fire was first discovered by a violent explosion in the sugar dust house on roof of adjoining building at the level of the eighth floor, and connected with the granulated sugar dryers. This dust room was constructed of light material (corrugated iron on outside, and plaster on wire lath on inside of four-inch steel angle framing), with the idea that should an explosion occur, it would be exerted upward and outward, and not injure or set fire to the building. This dust house was destroyed by the explosion, the steel angles being bent almost double. The fire got into the eighth floor by an unprotected window near the dust house.

When the explosion occurred, most of the workmen escaped down the stairs. The remainder started to fight the fire with the standpipe hose. The others, however, as they fled, opened the hose valves on the floors below in accordance with the notice quoted above, thus diminishing the pressure, and preventing an effectual fight being made. As the fire spread through the floors below, the same men fought it there, and held it in check to some extent until the fire department arrived. Lines of hose were taken up into the new concrete building opposite, and streams were directed from this vantage point. With supply from the city mains, three fire boats and from the pumps of three tugs, it was not long before the fire was under control.

Damage to Stock. Most of the stock on the fifth, sixth, seventh and eighth floors was destroyed. The sweet water in tanks on the ninth floor was saved, drawn off in tank boats and sent elsewhere to be refined. Stock on floors below the fourth subject to water damage only.

Damage to Building. Wood floors badly burned on fifth, sixth, seventh and eighth. The brick covering protecting the columns is in good condition, though in a few places it is chipped. Where the heat was most intense the bricks are spalled and the expansion has loosened the mortar to such an extent that the bricks may be pulled off by hand. The tile coverings of the beams and girders suffered more and are generally broken away where the heat was most intense. The beams do not seem to have suffered materially. The arches themselves are in almost perfect condition, although in a few cases the lower web is split off.

Lessons from the Fire. This fire shows clearly the hazard attending the pulverization of sugar and the need for conducting this process in a separate building, or the process should be conducted in a section cut off by a twelve-inch fire wall without direct openings to other buildings. The outer unexposed wall preferably to be of light material, such as plaster on wire lath, or terra cotta blocks, so that the force of any explosion may be vented outward. No dust room should be used. Dust from granulators and pulverizers should be settled by spraying in an enclosed chamber of incombustible material, thus eliminating the hazard of the dust room and dust tubes.

All pulverizing mills should be equipped with magnets and some form of explosion preventer.

The location of machinery and conveyors should be such as to necessitate as few floor openings as possible and stair and elevators should be enclosed in a standard manner. A bad feature of this plant was the wooden sugar bins passing through the sixth floor. When these burned they not only made large openings in the floor but the burning sugar flowed over the floors, adding to the intensity of the fire. These bins should be replaced by some form of incombustible construction.

S-11235. August 25, 1910. Mattress and Spring Bed Factory. Fire occurred at 5.10 p. m. in the three-story fire-resistive building occupied for garnetting and picking mattress stock, also for japanning, japan ovens and boiler room.

Fire started in the japan oven and dip tank room on the first floor. Building was of reinforced concrete construction, and equipped with automatic sprinklers. Sprinklers were 286° Grinnell glass disc, installed with pipes in 1904. Piping was the 1-2-4 schedule. Sprinklers were on the wet system, fed by waterworks at seventy pounds pressure. Eight sprinklers opened and held fire in check.

Fire was discovered and alarm given by employee and sprinkler alarm. A five-barrel japan or enamel dip tank was located on the first floor about ten feet from the gas-heated baking ovens. The tank was about twelve or fifteen inches in width, five feet long and five or six feet deep. The top of tank was level with the floor, while the body of the tank extended below the floor. The tank at time of fire was without cover. The japan or enamel dipping paint was thinned with benzine, making a mixture of about forty per cent benzine.

Fire was caused by employee lighting the japan baking oven. The method of lighting the gas burners in ovens was to roll a newspaper into a cylinder about thirty inches long, using it as a torch. This the employee did, and carelessly threw the ignited paper torch near the dip tank, which at once blazed up. The eight sprinklers which opened did not extinguish the fire, but checked it so that employees were able to rush into room and cover tank with wet burlap bags, smothering the blaze. Sprinklers were of value in preventing fire from spreading into the ordinary joist constructed spring bed building, adjoining and communicating through door opening. This opening was protected by an automatic fire door, which failed to operate under fire.

Damage to building and contents was small. The fire-resistive construction of the building was undoubtedly of much value in confining the severe dip tank fire to the room in which fire occurred.

S-11175. March 24, 1911. Tenant Manufacturing Building. Building was of fire-resistive construction. Fire caused by employee stepping on a match which ignited and set fire to the burlap wrapping on rugs, in basement used for the storage of rugs. Six sprinklers opened and held fire in check. It was necessary for fire department and private brigade to use several hose streams to complete the extinguishment, causing excessive water damage.

The basement was full of rugs at the time, rolled and wrapped in burlap, standing on end and not skidded. The large amount of water used in extinguishing the fire flooded the basement and practically every rug was damaged by water. Fire loss was not over $1,000, but the water damage brought the loss up to $23,000.

This fire shows the great value of fire-resistive construction in buildings which may be used for storage of stock in which fire may spread so that water from sprinklers cannot reach it from the obstruction to distribution. Many fires have occurred in the storage sections of wooden buildings where fire among the stored goods has burned through floors or into concealed spaces, causing large losses on stock. Floors and basements should be well scuppered and drained. The construction of this building was undoubtedly of much importance in preventing a serious fire loss.

H-6293. April 12, 1911. Manufacturing Lanterns. Building in which fire occurred was occupied for tenant manufacturing, fire starting on the fourth floor, used as finished stock room, and filled full of boxed lanterns packed with paper and hay. The factory was located on the floor above.

Building was of brick construction, with interior steel framework supporting eight-inch tile floors. Floor arches were tile segmental end construction, with four-foot spans. Beams and girders were protected by three-quarters of an inch of tile. Columns were protected by ten-inch tile blocks.

The fire occurred from unknown cause about 11 p. m., while plant was not in operation. It was discovered and public alarm given by an out-

sider. Building was without watchman or other auxiliary alarm service. From the statements of firemen, fire apparently started in a narrow aisle between piles of stock in wooden and corrugated paper boxes. The stock was piled to ceiling and practically throughout floor. This greatly delayed the fighting of the fire, due to the narrow passages between piles of stock, as in some cases only a foot aisle had been left.

Upon arrival of fire department chief a second alarm was given. Fire was extinguished by fire department using six heavy hose streams for a period of about one and a half hours. Loss approximately $42,000.

The fire-resistive construction of the building stood up well under the severe fire. Only the floor arches above the fire area were seriously damaged. The tile coverings on steel members were largely cracked off, but the steel supports appeared undamaged. Several window frames were also burned out. Considerable water damage resulted on floors below and in basement.

The result of this fire is an excellent example of the value of modern fire-resistive construction. The excessive quantity and close packing of the highly inflammable stock made a severe, quick-spreading fire, and one hard to control. It is doubtful that fire could have been controlled in an unprotected combustible building.

All floors in buildings of fire-resistive construction should be waterproofed, pitched to drain and scuppered.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

11137. December 12, 1910. Silk Mill. Soon after closing down, at 6 p. m., a sixty-six-inch boiler, twenty years old, exploded with terrific force, completely wrecking the boiler house and the walls between the boiler and engine rooms, and about twenty-five feet of the wall of No. 1 mill. The force of the explosion completely wrecked eight throwing frames near the wall in No. 1 mill. The large engine was not damaged. The twelve-inch steam header, also auxiliary headers to fire pumps, etc., were all completely wrecked. The roof of the main portion of the engine room collapsed, carrying with it the sprinkler system, leaving no automatic protection on the engine and boiler houses. The boiler which exploded was of the lap seam type, was tested May, 1910, and declared safe for ninety pounds pressure and the safety valve set accordingly. The safety valve of the exploded boiler has disappeared.

Fire was noticed immediately after the explosion in the oil and paint house, which contained some paint and oil stock and a large pile of paper covered rolls for the throwing frames. Fire was also seen in a short flight of steps and a coat and tool closet near the door leading to the engine room from the boiler house. A large hose stream and two lines of small hose were used by the mill men and a large hose stream was used by the town brigade supplied by the town steam fire engine stationed at the mill hydrant near the street at the entrance to the yard. The fire smouldered till the next day, the hose streams being used intermittently till the fire was completely extinguished. The static pressure on the city water was about sixty-eight pounds.

Because of the absence of steam for heat, all sprinklers were shut off and the systems drained to prevent freezing. There was but a small loss from fire.

Summary: Boiler explosion wrecked sprinkler system.

10992. December 29, 1910. Woodworker, Sash, Door and Blind Factory. The plant consisted of two groups of buildings detached twenty-five feet or more from each other. Buildings were mainly of light

open joist construction, with brick veneering or metal-clad. The group in which fire occurred consisted of two buildings two and three stories in height, adjoining and communicating without cut-offs.

Fire occurred from unknown cause at 7.30 p.m. in the sawdust and shavings vault in the three-story building. This building was thirty by twenty-four feet in area, of light open joist construction, with brick veneering on the first and iron-clad on the two upper floors. The second and third floors were practically one fire area, having three large openings fifteen by four feet each, with light canvas and wooden screens over them in the form of an inverted "V." In the third story there were wooden ventilators, or louvres, on all sides, those on the south side being over the roof of the adjoining two-story building. Chutes ran from third floor through which shavings could be discharged to driveway on the first floor and to boiler room. The two-story and basement building was approximately seventy by twenty-three feet in area, of open frame joist construction, iron-clad and mainly open finish except in the dry kilns on first floor. Second floor was approximately sixteen feet high and occupied as a shavings vault. The first floor was occupied for dry kilns, and the basement as boiler room, engine room and storage.

The boiler stack is brick and passes up through the two-story building about twenty-five feet from the three-story shavings vault building. The shavings and sawdust were conveyed from the main factory to the shavings vaults through galvanized iron pipes.

These buildings were protected by Esty No. 5 automatic sprinklers on a dry-pipe sprinkler system. Piping and sprinklers were installed in 1899, on the 1-2-4 schedule. Sprinklers were spaced seven to seven feet six inches across joists by eight to ten feet with joists, staggered spacing. Water supply was from city waterworks giving a static pressure of about seventy pounds on sprinklers opened. Dry system was controlled by a Manufacturers Wood dry-pipe valve without anti-column pipe.

The sprinklers appeared to have but little effect on the fire, the system undoubtedly being out of service at the time fire occurred.

As stated above, the cause of fire is not known. Blower system was not in operation at the time, and it is stated that the employee who piles the shavings does not smoke. The wind was from the south, and as boiler stack is without spark arrester, a spark may have been blown through ventilators into vault, or fire may have started in the blower pipe and smouldered, later breaking into flame.

Engineer discovered fire and gave alarm at 7.34 p. m. He stated under oath that the first knowledge of fire was when he heard the sprinkler alarm. The firemen state that at the time fire alarm was received the glow of fire could be seen in the sky and was also noticeable from a distant part of the city at the same time.

The fire department recall was sounded thirteen minutes after reaching the plant, as the fire, although burning fiercely, was easily controlled.

Sprinklers in fire area were located as follows: three-story section, twelve on top floor, fifteen on second floor. There were approximately seventy-five in the large shavings vault on the second floor of the two-story section. Sprinklers were opened as follows: twenty-six in the two stories of the three-story building and twenty-eight in the top story of the two-story building,—fifty-four in all.

There was no obstruction to distribution in the location where fire actually started, but more than half of the sprinklers and piping in the larger shavings vault were buried in the shavings. The walls and ceilings of second and third floors of the smaller vault are all badly charred, so that it would indicate that the sprinklers had not discharged any water, this supposition being apparently supported by the evidence of the bright glow being seen at some distance. A few of the joists of ceiling in the larger shavings room are slightly charred. The district chief stated that the sprinklers were not working when he reached the upper floors, but the engineer claims the system was shut off shortly after firemen's arrival. Another fireman states that he was among the first to reach buildings and the sprinklers were not discharging any water at that time. In contradiction of this, is the sworn testimony of the engineer that the sprinkler alarm gave the first notice, and also a statement by the district chief that in his opinion the sprinklers had operated, or the damage would have been greater. The sprinkler equipment in this plant had been found out of service several times in the past. Loss $3,000.

Summary: Water shut off from unknown cause.

11237. February 6, 1911. Woolen Mill. Storehouse was two stories high, of brick, joist construction, and one hundred by fifty feet in area. Floors and roof were supported on two lines of wooden posts extending from roof to brick piers in the shallow basement. Girders were self-releasing where entering side-walls. Warehouse was protected by Grinnell glass disc sprinklers, supplied by waterworks at sixty pounds pressure. There was a four-inch riser on each floor supplying sprinkler system. The water supply in this storehouse was kept shut off in winter and was controlled by a valve in the engine room basement.

At the time of fire the storehouse was nearly full of various kinds of waste stock. The watchman in making his rounds entered the storehouse through a door from an adjoining building. There was a station at the farthest end of each floor, which he rang once an hour. As he opened the door at eight p. m. he saw fire burning in a pile of sulphur-dyed black cotton waste near the foot of the stairway which extended from the lower floor to the upper at the east end of the building. The mill had been experimenting on this particular kind of sulphur dyeing for some time, as there had been indications that it was liable to spontaneous ignition. Watchman used four pails of water, but finding that he could not cope with fire, closed the double fire doors and went to the engine room basement and opened the sprinkler controlling valve. He then rang the factory bell, all of which consumed at least ten minutes since he had first

noticed the fire, and quite likely the fire had been burning ten minutes previous to that time. At all events it had gained such headway that it quickly spread to all parts of the building, probably passing up the stairway near which it started, so that someone on the street saw the fire and gave the public alarm. The department responded quickly and reached the mill almost as soon as the mill help.

The 1,500-gallon Underwriter pump and a Knowles single pump were started at once, and ran smoothly and well throughout the fire, giving good pressure and excellent hose streams, so good in fact that they were handled with difficulty by the men. The static pressure from the public water supply at this mill is sixty pounds, and altogether there was an abundance of water. The night was cold, the thermometer being but a little above zero. The firemen soon became coated with ice, and the fire was fought with difficulty. Most of the stock in the warehouse was loosely packed in bags, nearly all oily, which made a particularly hot fire and dense smoke. A little fire spread into adjoining building, but sprinklers opening, protected the building and contents.

The twelve streams that were used on the fire seemed to make but little impression for a long while, and it was impossible to get near the fire to fight it at close range. Finally the roof and second floor collapsed, putting the sprinkler system entirely out of service.

The walls were standing after fire, although somewhat injured, especially at the west end, but the girders came out of the recesses in the wall very nicely, doing but little damage, there being ample room above the end of the timber. The double windows, with their casings, were destroyed, as were all the doors except the fire doors at east end leading into adjoining building. There was a large doorway on both stories between these buildings, protected by standard tin-clad fire doors on each side of the opening. The heat was so intense that the doors toward the fire finally collapsed, but by this time the fire must have begun to lessen, as the inner doors were still in place and not seriously injured. This is a most striking example of the defense offered by double standard fire doors against great heat.

The smoke from the burning oily waste was so dense that no reliable information could be obtained regarding the operation and distribution of the sprinklers after the valve was opened. This condition continued up to the time the second floor and roof had fallen, which of course destroyed all the sprinkler equipment.

Summary: Water shut off to prevent freezing.

11301. May 27, 1911. Corset and Paper Box Factory. Fire started at 12.34 p. m. in a one high story, equal to three and a half stories, skating rink, spreading to a three-story brick-veneer building, several dwellings and a frame carpenter shop; destroying all of these buildings and severely exposing other dwellings, stores, etc., and the corset and paper box factory equipped with automatic sprinklers.

The skating rink was of large area, approximately one hundred and twenty-five by seventy-five feet, extending through from street to street, and was of frame joist construction and metal-clad. The cause of the fire is unknown. The wind was blowing with considerable velocity, which carried the flames towards the corset factory, but it was stated that no water from hose streams was used on the factory until about three o'clock, or about two hours and a half after fire started. This was after the walls of the burning building adjacent had collapsed. Fire spread over neighboring buildings with great rapidity.

The corset factory was located across the street, thirty feet from the rink. The factory also made paper boxes and consisted of two main sections with a wing and several smaller buildings in the rear, occupied as boiler house, stable, wagon shed, etc. The two main sections were of brick, joist construction, four stories in height, approximately forty-five feet to the peak of the roof, the fourth floor being a mansard roof, iron-clad, with a heavy wooden cornice overhanging the third story. Floors were double, except first floor of the west section, which was concrete laid on the ground. Ceilings of west section were open joist, and those of the east section mainly wood sheathed. There was a frame enclosed stairway in the west section, also an elevator with automatic traps. In the east section there was a frame enclosed stairway on several floors, but the main stairway and elevator were in a brick tower cut off by good automatic tin-clad fire doors. Over the top of this stair and elevator shaft was located the sprinkler tank, which was enclosed in a frame, iron-clad tower. There was also a frame, iron-clad clock tower extending above the roof. A brick wall, with mainly standard automatic fire doors at the openings, cut off the two sections from each other. The size of the main section was ninety by forty feet, and of the east section two hundred by forty feet, but forming one area on three floors with this east section was the new wing, one hundred and seventeen by fifty-six feet. The construction of this wing was brick walls, five-inch floors, plank on steel girders, and wooden columns, the girders being encased in wood. The walls of all buildings were mainly open finish except at the mansard, but there was some wood sheathing on floors below the mansard.

With the exception of the top of the sprinkler tank tower, and a low blind roof space on the new wing, the plant throughout was protected with automatic sprinklers of the Rockwood "B" type in the new wing and wagon shed adjoining; Niagara-Hibbard "B" balance. The water supplies were two city connections from independent mains in Dorchester and Charest Streets, and a 20,000-gallon gravity tank located in the frame, iron-clad tower over the elevator and stair shaft. Elevation of tank above the main sprinkler lines twenty feet; normal city pressure forty pounds except at certain hours of the day, such as the noon hour, when on account of the heavy draught, pressure is reduced to twenty-five pounds. A static pressure of forty pounds would give some twenty-five

static pressure on the main top sprinkler lines, and when the city pressure is drawn down, the tank would give a pressure of some sixteen pounds on the main top sprinkler lines. A water curtain of seventy-six heads of the shovel type protected the front exposed to the roller skating rink, the heads being located at the windows on the second, third and fourth floors, including those of the elevator and stair shaft and also under the wooden cornice. The two city connections for the automatic sprinkler system also supplied the water curtain. The sprinkler system in the main section and also the water curtain were installed in 1908, and the sprinklers in the new wing in 1910. The spacing was good, running from six feet six inches to ten feet six inches with by seven feet six inches to eight feet across the joists, staggered under both open joist and finished ceilings; and nine by eight feet and seven feet six inches by eight feet under pocket construction in the new wing. Sprinklers were also located under sewing tables, etc.

With the exception of this property, none of the buildings involved in the fire was sprinklered. The public waterworks protection in the section where fire occurred was defective. A concentration of water for fire purposes has to be resorted to whenever an alarm of fire is sent in, owing to the consumption being excessive and the supply mains not being of sufficient capacity to maintain adequate pressure for fire purposes throughout the city. This concentration means the cutting off, either entirely or in part, of the water supply to other parts of the city, which involves great risk of a conflagration should simultaneous fires occur in different parts of the city, as is proven by the present fire. Tests have proved that the time taken to concentrate a fire pressure varied from seven and one-half to twenty-eight minutes.

On the day of the fire there was a small fire about noon in an adjacent fire district, and pressure for fire purposes had been concentrated at this point. As the buildings involved in the conflagration were located west of this, it is reported that when the alarm was sent in at 12.34 for the fire in the roller skating rink, there was only nine pounds pressure shown on the gauge in No. 3 fire station diagonally opposite across the street.

There are usually ten men on duty in fire station No. 3, but at the time of fire five had gone to dinner and four were on the way back from the small fire above referred to. This left only one man in the station when the alarm came in for the skating rink, which led to delay not only in laying the hose but also in reconcentrating the water pressure from the east side to the west, so as to be available for this fire.

The sub-chief, who lives near fire station No. 3, was at dinner when called, and seeing the seriousness of the fire, sent in a general alarm.

There was undoubtedly delay in despatching the firemen in No. 3 station to manipulate the valves to obtain a fire pressure, and it was due to the failure of one of these men to open the valve controlling the twelve-

inch main that no fire pressure was obtained until some three hours after the fire started. Assistance was called from two neighboring cities, which arrived about 1.30 p. m. The equipment from one of these cities was of no value in fighting fire, as the hose coupling threads were not standard and connections could not be made. The hydrant mains are largely four-inch in this section. A considerable quantity of the hose was found to be in poor condition.

By this time fire was severely exposing the sprinklered factory. The building was equipped with two two-inch standpipes with two-inch hose and five-eighths-inch nozzles, supplied by the city water independent of the sprinkler supplies. The owner stated they used this hose for a short time after the start of the fire in the rink, until requested to discontinue same by the fire department. They also claim to have opened the post indicator valve controlling the water curtain some ten minutes after the fire started in the rink. There is doubt as to when this valve was closed, the fire department claiming it was shut about 2 p. m., while the owners state it was left open during the fire. It is doubtful, however, if the open sprinklers above the third floor had any water at any time.

Owners state that when they felt the fire would enter their building, they did not wait for the sprinklers to open from the heat, but knocked the heads open, commencing on the fourth floor, and opening those on the floors below when there was danger of fire extending to them. The heads in the blind roof space were opened by the heat, also some in the stairway and the elevator shaft and clock tower, also the sprinklers on top floor of new wing, as the smoke and heat were too great for owners to enter. Apparently most, if not all, of the sprinklers that opened on the fourth, third, second and first floors of the two main sections, and the second and first floors of the wing were knocked open by the owners. While all of these sprinklers were not opened in the beginning, it is probable that with the seventy-six heads of the water curtain they were a severe tax on the water supply. A representative of the Underwriters stated that he entered the corset factory about 1.15 p. m., and there was a perfect flood of water on the first or ground floor coming from the upper floors. It is also reported that while there was a considerable amount of smoke coming from the corset factory, there was no large volume of flame until the fire seemed to spread over the whole roof at once, and it would thus appear that a certain amount of water had been discharged from the sprinklers.

It is reported that the fire department shut off the sprinkler controlling valves about 3.30 p. m., but it is also stated that they were immediately reopened by the owner and the sprinklers left in service until about 5.30 p. m. It was likewise stated that the water curtain valve was shut by the firemen about 2 p. m., but, as previously stated, owner claims it was open during all of the fire.

There are numerous rumors to the effect that there was no water in the sprinkler tank at the time of the fire. Even if the tank had been full,

with the large number of sprinklers that opened, it would have lasted but a short time; but would have been of value in giving a fair pressure to the sprinklers in the blind roof space and top floor.

The fire damage in the corset factory was as follows: The fourth floor and blind attic of the west section were destroyed. The sprinkler tank, and tower enclosing same, and the clock tower have collapsed. The third (top) floor of the wing was badly burned, so that it will have to be replaced, and all the window frames on this floor were destroyed; also a part of the sewing tables was burned. The ceiling of the second floor of the east section was badly burned in places, and partly collapsed, the joists above being charred; also a small section of the steel ceiling of the first floor had fallen, probably from the weight of water. The stock and machinery on all floors were heavily damaged by water.

The fire doors throughout the factory were apparently open. This, however, it is not believed had any bearing on the spread of the fire, as the fire entered both sections from the outside exposure.

Summary: Conflagration.

The failure of the water curtain and the automatic sprinklers in the corset factory to check the fire was undoubtedly due to the lack of water on account of the low city pressure, which was due to the failure to properly concentrate the fire pressure. The same reason can be given for the inefficiency of the hose streams.

Investigation after the fire relative to the method of concentrating waterworks supply in case of fire showed that while there were three different schedules in existence for the operation of the valves for concentration purposes, none of them had received the approval of the waterworks engineer as being correct under the present conditions. It was found that no written or printed schedule of such valves necessary to be operated had been posted in any of the fire stations, and consequently the men had to depend entirely upon memory. It was also brought out at the investigation that at least one of the men could not read, and printed instructions to him would not therefore have been of much use. It happened that this was the very man who was responsible for the operation of the valves for concentration in connection with this fire, and he admitted on cross-examination that he had omitted to open the twelve-inch valve, thus preventing the fire pressure from the twelve-inch main reaching the district where the fire occurred. This valve was not opened until about 3.30 p. m., when almost immediately sufficient fire pressure was received. It was stated by the officers of the fire department that had the same pressure been available at the start of the fire. the flames could have been confined to the building in which they originated.

To reconcentrate the pressure from the first fire section to the section of the conflagration required the operation of eleven valves in all.

11194. April 28, 1911. Saw and Planing Mill. Fire which occurred from unknown cause at 4.10 p. m. practically destroyed all mill buildings with the exception of power house.

The main mill was from two and a half to three and a half stories high, two hundred and ten by forty-five feet in area, with wooden walls covered with shingles. Floors and roof were of joist construction, with numerous belt holes, waste chutes, carriers, etc., passing through floors. The roof was covered with tar and gravel proprietary roofing. There was also a one-story frame addition on the west of main mill approximately forty-five by one hundred feet in area.

The power house was basement and one story in height; eighty-two by forty-four feet and thirty feet in area; of brick construction, and was cut off from main mill by a twelve-inch brick wall parapetted three feet above power house roof, and winged three feet at each end against main mill. There was no doorway through this wall. There was one opening from mill to boiler room for refuse carrier, and a belt hole in engine room.

The detached new mill, which was just about completed, was situated east of the main mill and was forty-six by thirty-two feet in area, of frame construction, and two and a half stories high.

The main mill, addition, and boiler house were equipped with a modern standard sprinkler system: Rockwood issue "A" sprinklers on 1-2-3 schedule of pipe sizes, spaced eight feet ten inches with joists by eight feet across two-foot bays. Sprinklers were on dry system, but water was turned on at the time of fire. System was supplied by waterworks as primary supply, giving eighty to ninety pounds static pressure on sprinklers, and by steam fire pumps as secondary supply. All sprinklers opened in main mill and addition, but were unsuccessful in checking fire.

The plant had been shut down for the winter and was being repaired, and the new mill constructed preliminary to starting up again, when the fire occurred. About forty men were working about the buildings. At 4 p. m. men who were working at the large band-saw, which extended from first to second floor, saw a small blaze under the lower band-saw pulley frame on first floor. The men immediately gave alarm and employees at once used the fire hose supplied by fire pump.

The cause of fire is unknown, but was probably due to carelessness in upsetting a lantern or dropping a match.

Fire spread throughout the building so rapidly, aided by the high wind which created a strong draught through the open doors and windows, that by the time hose streams were in service the fire was beyond control. Help was summoned from nearby towns and four hose streams were used by the firemen who responded. Two hose streams were used from steamer pumping from river, and two from public hydrant. Employees used four streams from steam fire pump. The outside protection saved the frame blacksmith shop, which was not damaged.

Investigation after the fire showed that without doubt the sprinkler system was in service, although it had practically no effect on the fire. A

sprinkler in engine room held fire from spreading through refuse carrier hole.

The fire wall between mill and power house proved very effective and the wired glass skylight held up perfectly, although the glass was badly cracked.

After the start of fire it appeared to burn from the outside. The doors and windows were open and a strong wind blowing, with heavy draughts through mill. Fire almost immediately came out the doors and windows, spreading with great rapidity in all directions over the outside dry shingle-clad walls. The factory had been closed down all winter and was dry as tinder, and the timbers, ceilings, etc., covered with a fine dust that burns with explosive vigor. When a factory of this class is running, the constant passing of wet logs through the plant dampens the framework and fills factory with a damp green bark dust that will retard the rapid spread of fire. It was this dust that in the spring had become so dry and inflammable.

The cause of failure appears to be due to the following reasons:—

1. Obstructions to distribution offered by pulleys, braces, timbers, etc.
2. Large unprotected floor openings at band-saw pulleys and in various other places in mill.
3. Draught caused by strong wind through open doors and windows.
4. Ineffective distribution under heavy joist construction.

To these also might be added excessive dryness and presence of dry impalpable dust throughout premises; weak primary supply under conditions of heavy draught and poor judgment in taking four hose streams from pump, thereby taking a considerable portion of the secondary supply away from the sprinklers.

Summary: Not classified.

11199. May 6, 1911. Cigar Box Factory. Fire occurred from unknown cause at 5.30 a. m. in the two-story brick dry kiln building No. 7, spreading into stock of cigar box lumber stored on roof, and exposing windows on the third and fourth floors of building No. 4, which were above dry kiln roof.

Dry kiln building was two stories high, with four kilns nineteen by nine feet and twelve to thirteen feet high. The west wall was brick and adjoined the east wall of building No. 4. The east wall was composed of the usual canvas curtains. The first floor of kilns had a joist ceiling; the second floor ceiling was sheathed with double boards on the underside of roof. Roof was slag covered. There were frame partitions between kilns, forming an eight-inch hollow space between each kiln. The sheathing of these partitions was double boarding. This hollow space extended from first floor to roof and apparently communicated with the concealed space of roof. On top of each of these ducts, or concealed spaces in partitions, there were one or two wooden ventilators on roof, twenty-four by eight inches and about five feet high. In each kiln there

were two openings into these ducts, closed by a wooden slide, the idea being that the ducts would serve to carry off the moist air from kilns through the ventilators. The ventilators had a wooden top or hood, open at the edges. Kilns were steam heated, steam pipes being well arranged on metal supports.

There was a complete system of automatic sprinklers in kiln and adjacent building. Sprinklers were the International head, installed in 1907; spaced eight feet with joists by seven to about eight feet across joists, staggered spacing. Pipe sizes were the 1-2-3 schedule. Sprinklers were on the wet system, supplied by a 7,500 gallon pressure tank at seventy-eight pounds pressure. Two gravity tanks of 15,000 gallons combined capacity also furnished some water during the fire. Thirteen sprinklers opened in dry kiln and three in stairway of building No. 4. The sprinklers prevented fire from entering No. 4 building but could not control fire in kilns, as fire was in the ducts, in partitions and in the hollow ceilings.

At the time of fire the eight kilns were nearly full of lumber, consisting of plain oak, quartered oak, chestnut and a little bass wood, piled up to about three to four feet from ceiling and each layer on strips. The wooden slides, covering openings into hollow spaces between kilns, were open in some cases. The afternoon before fire occurred a half carload of Spanish cedar boards for cigar box lumber had been received and had been piled on roof of dry kiln. This lumber was in thin strips and had been laid in piles four or five feet high with strips between the layers. Had this lumber not been located on roof, fire would probably not have assumed such proportions.

On the night of fire watchman made his 5 a. m. round, starting at 4.59 a. m. and finishing at 5.20 a. m. He rang in box on fourth floor No. 4 at 5.05 a. m. and must, therefore, have passed up or down the stairway at this time, but did not detect anything wrong on roof of dry kiln and did not notice any odor of smoke. He was washing up in boiler room on first floor of No. 4 building when one of the drivers or teamsters coming in noticed smoke, and told the other men he thought there was a fire somewhere around the kilns. The three men went up through building No. 4 and found fire on roof of dry kiln, but accounts seem to differ as to whether fire was in the lumber noted on roof or coming out of the wooden ventilators described. The men got out the two and one-half inch hose on standpipe in building No. 2 (adjoining No. 4 on south) and attacked fire from the fourth floor windows, but with apparently little success. They also used several chemical extinguishers and some fire pails. Leaving two men at the hose, watchman ran down to boiler room and turned in an alarm on the local telegraph box and then tied down whistle on boiler house. For some reason the alarm over the telegraph box did not record and it was not until several minutes later, when an outsider pulled the fire alarm box, that the alarm reached fire department. This alarm is said to have been received at 5.30 a. m.

The department had quite a fight to extinguish fire, as so much of the trouble was in the hollow spaces between kilns and later in the lumber in kilns, but by 11 a. m. had fire extinguished.

Engineer shut off dry kiln sprinklers about 6.45 a. m., and after that fire was fought entirely with hose streams.

The hollow spaces between the kilns were charred on the inside and burned through in places, the openings into kilns being charred around edges, showing that fire in some instances had come from these hollow spaces out into kilns. The hollow space in roof was badly charred, the roof being burned through in places; the wooden ventilators on kilns were burned off and the cedar boards stored on roof badly burned, some being burned up.

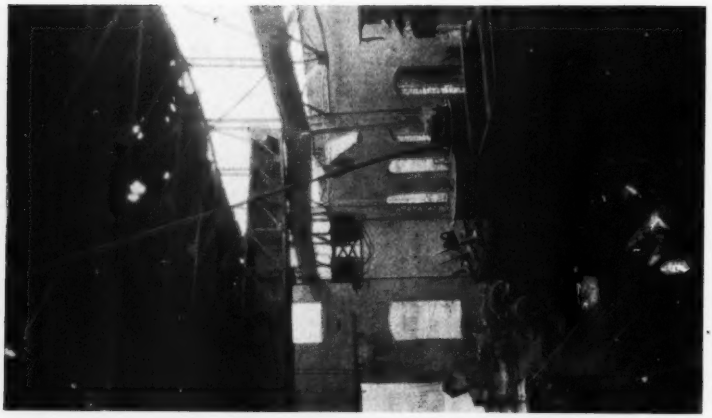
Summary: Concealed spaces rendered sprinklers ineffective.

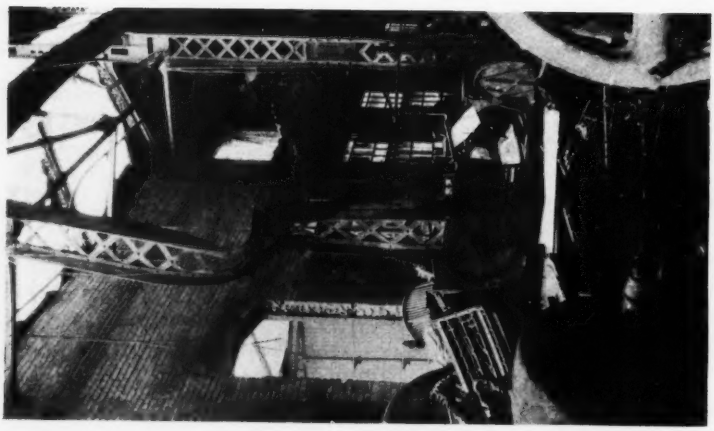
11304. May 6, 1911. Electrical Appliances. The electric testing building in which fire occurred was of brick with pitched roof, situated roughly in center of the plant, twenty feet to fifty feet distant from brick machine shop on north and thirty feet distant from brick foundry on south, all three buildings extending in a generally east and west direction. Adjoining the testing building at the west were the engine and boiler rooms. The latter were cut off from testing building by a twelve-inch brick wall, with a good metal-clad fire door in opening on first floor kept closed at all times. There were a few other openings in this wall around sprinklers and heating pipes. These were mostly small.

The testing building comprised two sections: one sixty by one hundred and twenty feet, one story high, at east end, and the other sixty by eighty feet, two stories high, at west end. The sections had no division wall, curtain boards, or other fire stops between them, the entire area being one fire section.

The roof of the larger section was two-inch by three-inch plank on edge, supported on six-inch by eight-inch timbers on flat "T" shaped steel truss, and covered by tarred paper. The "T" trusses were ten feet to ten feet three inches apart, supported on eight-inch by five-inch steel columns made up of two eight-inch channel beams, reinforced by flat one-half inch braces riveted to them. The walls of the building were twelve-inch brick, and supported some part of the roof load, as the main roof of this section was really a large monitor one hundred and twenty by forty feet. Eight feet below this roof the supporting columns enlarged to ten inches by eighteen inches, to carry twelve-inch by twenty-four inch longitudinal steel girders each side of shop, which supported the traveling crane, extending from extreme east end of shop to the two-story section. The large steel columns, as above, were of rather peculiar design, and built as follows:—

Four angle beams, each three inches by five inches face, were connected by two-inch flat diagonal braces, spaced about twelve inches apart. Entire structure riveted. (See photograph.)





Unsatisfactory Sprinkler Fire S-11304.

These columns were spaced twenty feet apart throughout the length of the building.

The floor of this section was cement at sides and two-inch plank on ground in center of shop.

The roof of the two-story section was of one-inch boards on joists supported on four-inch by six-inch wood timbers on steel truss, — except the monitor, fifty by fifteen feet, eight feet high, supported on wood truss. The metal trusses were "T" shaped, spaced about ten feet apart. The columns were five inches by eight inches as in larger section from main roof to floor, spaced twenty feet apart as in larger section. The second floor and roof were supported by the columns and brick outside walls. The second floor was of four-inch plank on edge on heavy joist about thirteen feet centers. The ground floor was cement, except small section of wood planking.

Communication from first to second floors by large open staircase.

Eight feet above second floor were two decks of light board, supported by flat iron truss rods. One deck was partially enclosed. Nine feet six inches above floor of larger section was a gallery thirteen feet six inches by sixty feet on north side of room and on south side was another gallery twelve feet by sixty feet. These were of light plank flooring on joists.

On north and south sides of building were numerous windows of light glass in wood sashes. On west was engine room wall, on east was brick wall with large wood door and windows above and at sides. North and south sides of monitor roofs had light window glass in wood frames.

The testing building communicated with machine shop through two metal-clad passageways, with fair metal-clad fire doors at openings, though at the easterly passage, there was a glass window in wood frame above fire door. This building also communicated to adjoining impregnating building, nine by forty feet in area on north, of brick joisted construction and two stories in height. Good and fair fire doors at openings.

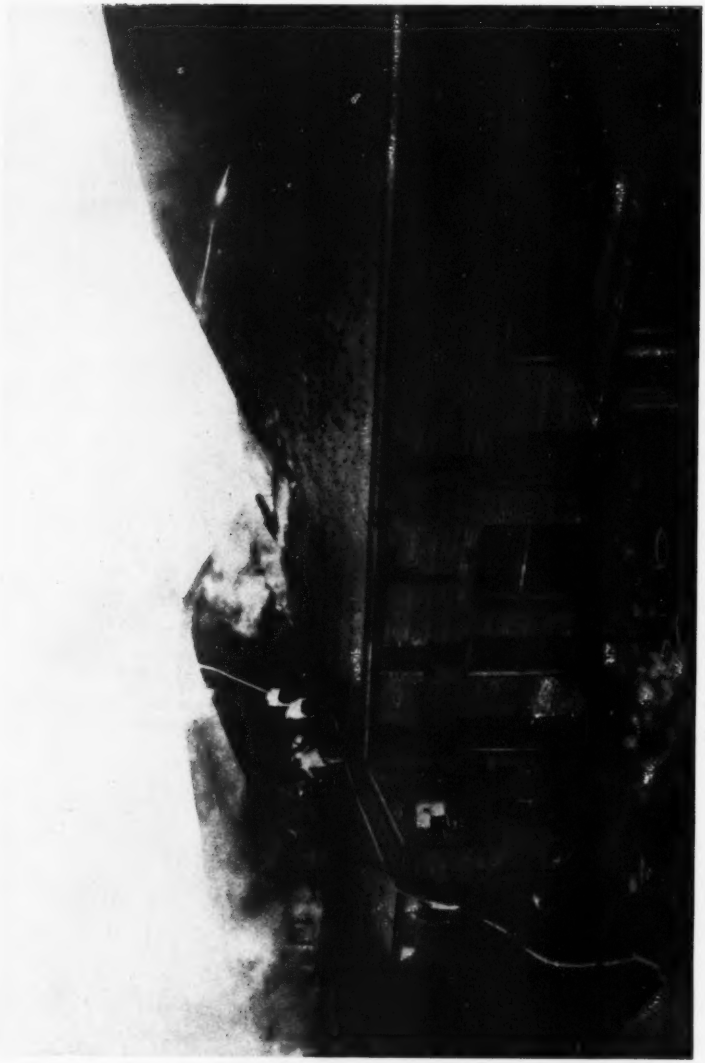
Impregnating building also contained brick and concrete core and armature drying ovens.

Occupancy.—The larger section was for electric machine testing before shipment, and contained a varied assortment of dynamos, transformers, etc., set upon the floor.

The south gallery in this section was used for transformer sets used in ordinary tests. Each transformer containing fifty gallons of transformer oil, six being on gallery at time of the fire. Under this gallery were two "filtering" tanks, each containing about 300 gallons of oil.

At the time of the fire, a special set for testing a 400,000 volt transformer had been arranged in center of testing floor, and just previous to the fire a tank containing from 1,800 to 2,000 gallons of transformer oil had been shunted into shop on a flat car.

The north gallery was particularly for convenience in handling



Fighting Unsatisfactory Sprinkler Fire 11304.

armatures and insulation before putting them in drying rooms or impregnating tanks, and after taking them out of same.

The two-story section was occupied on first floor for stamping metal commutator and armature sheets, etc., and on second floor for armature and coil winding, core making, etc., including oil and shellac coating of cotton and linseed oil coating of paper. On the two decks were stored the raw materials for use in this work. Some brazing and soldering was done here by a gasolene blow torch, in charge of a man who went from bench to bench as needed.

Protection.—The entire building was protected by an equipment of Grinnell glass disc sprinklers installed about 1901.

The pipe sizes had been overhauled and were generally 1905 standard, but owing to additions the two three and one-half inch risers in east end supplied one hundred and twenty heads (fifty-eight on south riser, sixty-two on north riser, including fourteen in cut-off impregnating building on north riser). These heads were fed from six-inch connection controlled by outside post indicator valve from eight-inch yard main.

The sprinklers in west end of shop, sixty-seven on upper floor and fifty-seven on lower floor, were fed by a three and one-half inch connection from four-inch riser in engine room, with four-inch valve control in engine room and with outside control also by post indicator valve on six-inch connection from eight-inch yard main.

The eight-inch yard main was fed by eight-inch discharge from a 1,000-gallon steam pump located in engine room and by a six-inch connection with six-inch meter in connection, and a by-pass six inches around it from a six-inch or eight-inch street main which ran to a dead end about 1,000 feet east of plant, and which was supplied by a fourteen-inch main about two-thirds of a mile west. The steam pump drafted from the canal through a twelve-inch suction approximately 600 feet long and an eight-foot lift when canal is full. Suction had foot valve and strainer at canal, and had a gate valve in it about one hundred feet from canal end of suction. This pump had been tested just before fire, and was reported in poor condition at the time, and it had been recommended that the pump be thoroughly overhauled, as owing to the normally low city pressure, in case of fire the plant would be rather crippled for efficient hose streams.

The fire pump had a 500-gallon priming tank a few feet above it in engine roof, fed by city connection. The waterworks is supplied by pumps drafting from river as follows: One two million gallon electric pump; one one and one-half million gallon electric pump, and two one million gallon Blake steam pumps. Under normal conditions the waterworks is fed by the two million gallon electric pump at a pressure of fifty to fifty-five pounds at station, giving approximately forty pounds static pressure at plant, which is about one mile east of pumping station.

Story of the Fire.—Fire started at about 5 p. m., Saturday, May 6,

1911, when there were only four or five men in testing shop, and perhaps twenty or thirty men in machine shop close at hand.

The cause seems to have been due to accidentally spilling some of the transformer oil from the large tank on flat car, when the core was being lowered into this tank by electric crane. It is understood that a coke fire had been built under the tank to presumably keep moisture out of the oil preparatory to the test. This was done in the yard. It was thought that coke fire had been extinguished before the car was brought into building, but it is probable that it was still smouldering when the oil was spilled, causing oil to take fire, and apparently running to the tank itself, which is said to have been ablaze inside shop after six o'clock. Shortly after six it was pulled out of shop on the car to a point some five hundred feet east. On investigation of this tank a half-inch threaded hole was found in case twelve inches below the top of tank, which was probably the cause of tank overflowing.

The fire apparently opened a large number of sprinklers at the same time that employees were starting pump and laying several lines of hose, which undoubtedly greatly reduced the pressure on the sprinklers, as it was proved after the fire that the pump could not have supplied over one good stream, to say nothing of supplying two or three hose streams beside the opened sprinklers.

A few minutes after the fire a neighboring plant sent a brigade of nine men with 500 feet hose, who laid two streams of 250 feet each from the hydrant near engine room.

The fire department, three miles distant, arrived and laid one 300-foot stream, which was said to have been in service until after 7 o'clock.

The reports are that nine or ten streams were in service during fire, which would indicate that employees used four or five streams. Two of these are said to have been taken from hydrant just south of the electric testing building near foundry. One from hydrant near engine room, to which the brigade from adjacent plant had coupled, one from hydrant near office building, and possibly one from hydrant at east end of testing building.

The chief arrived at fire about 5.15 p. m., and states that sprinklers in west end of testing shop were operating, but under very little pressure. The general foreman of shops states that the sprinklers were shut off at 5.40 p. m. District chief arrived at plant at six o'clock, and stated that no sprinklers were in operation then.

The supplies to hose streams were waterworks, pumps and plant pump. The steamer was not used, owing to low pressure apparent upon arrival of department and fear that the steamer would take all the water if coupled to hydrant. The steamer could not gain access to canal, owing to a low railroad trestle over the cut from yard to canal bank.

Of the 230 sprinklers in the building 173 operated with little or no effect, apparently due to lack of pressure, which may be strengthened by the appearance of sprinkler head removed after fire, which showed condi-

tion of orifice to be perfectly normal, whereas the deflector was entirely melted off by the heat, indicating that the water was just bubbling above valve seat of sprinkler, but without sufficient force to strike deflector.

The streams in use, of however little pressure, were sufficient to keep flames confined to the building in which fire occurred.

Practically the entire roof is gone, sprinkler piping fallen down, all the machinery on testing floor was badly damaged by fire and water, and ten-inch by eighteen-inch steel column buckled so badly that it will have to be replaced, some other small portions of the steel work are warped, though the appearance of the steel supports is in general rather better than might have been expected under the conditions.

The electric crane is temporarily out of commission. All the testing apparatus is valueless. The sprinkler system is out of commission, owing to falling in of roof. About fifty-seven heads, however, are in service first floor of west section.

The failure of the sprinklers was undoubtedly due to the inefficient water supply, brought about by the fact that the fire pump, which was relied upon to reinforce the primary supply, was in poor condition at the time of the fire, and also that a large number of hose streams were used. It is probable that if, at the start, reliance had been placed in the sprinkler protection, it would have been of some service in checking the fire.

This was the first test made by the plant of a transformer of this voltage (400,000), but if the method used is to be the common practice in such cases, all such testing should be done in a fireproof building, thoroughly protected, and either detached or properly cut off.

Summary: Defective water supplies and severe hazard.

11204. May 10, 1911. Furniture Factory. Fire from unknown cause started at 7.26 p. m., in the unsprinklered frame metal-clad elevator shaft, located in the northwest corner of the interior light court. The building was basement and six stories in height, of ordinary open joist construction, and was built around an interior court, under which was the fire-resistive boiler room. The elevator shaft in the northwest corner of the court communicated with each floor of the building through two openings protected by steel doors. Doors were constructed of one-thirty-second to one-sixteenth inch sheet steel on flat steel frames, and were hung with indifferent hardware over stone sills with about one inch overlap. The doors did not overlap enough to completely cover the wooden lintels under arches.

Building was occupied for the manufacture of desks, sideboards, boxes, etc., doing machine and hard woodworking, but no finishing, with the exception of a little filling.

The building, with the exception of the elevator shaft, was equipped with an old system of automatic sprinklers, which were of some value in checking fire, although their operation could not be considered satisfactory, and probably would have been of very little value without the heavy pressure from high pressure waterworks system, which was coupled

to the system by the fire department. This caused a number of heads to open which had remained closed under the light pressure from the primary gravity tank water supply.

Sprinklers were the N. Y. and N. H. elbow type, installed with pipes in 1890. Pipe sizes were the 1-3-5 schedule with end central feed. Sprinklers were spaced eleven feet across joists by seven feet four inches with joists, not staggered spacing. The system was wet at the time of fire, supplied by gravity tank, giving from nine to twenty-three pounds pressure. Secondary supply was steamer connection from high pressure waterworks system.

The fire was discovered by an outsider, who gave alarm through public fire alarm box. Watchman discovered fire about one minute later and sent in alarm over the Gamewell auxiliary box on the first floor of building. The watchman, equipped with portable clock, made two rounds before fire, the last one registering about 7 p. m.

The cause of fire is unknown. It evidently started at the foot of the elevator shaft, entering the building around the edges and over the tops of doors on the fourth, fifth and sixth floors, but was held from entering on the first and second floors. Fire also entered the third floor through a four by twelve-inch hole in the brick wall about six feet above floor through which the elevator cable passes into building to winding drum.

Upon arrival of the fire patrol, the entire elevator shaft was in flames and fire appeared to be entering the floors. The patrolmen notified the fire department that the building was equipped with automatic sprinklers, and a three-inch hose line was laid from a high pressure hydrant to the steamer connection of sprinkler system. This gave a pressure of one hundred and twenty-five pounds. The sprinklers were in operation at this time, but were of limited value on account of sticking of the unreliable heads under the light pressure. After connection was made with the high pressure system, the effect of the sprinklers on fire is said to have been more noticeable. The high pressure connection was kept on sprinkler system for about thirty minutes.

Fifty-five sprinklers opened in all. It appears certain that the sprinklers did fairly effective work in holding the fire in check, preventing its spreading and apparently extinguishing it in some places. In many places, however, the effect was questionable. Thirty-five sprinklers fused and started to open, and then either stuck or were resoldered by the water cooling the melted solder. Eight or more were exposed to considerable heat but did not fuse or start, with exception of three which fused but did not open. The work which the sprinklers are credited with doing was undoubtedly due to the use of the fire department connection and the high water pressure which caused many sprinklers to fully open which otherwise would have remained closed under the light primary water pressure.

The elevator shaft was destroyed, a small area of the three floors

burned and the stone lintels on elevator side of walls were badly spalled. There was considerable water damage on all floors.

The fire brought out the following points: Obsolete and unreliable types of sprinkler heads and systems cannot be depended on for efficient service. Primary water supply should be of good volume and pressure. All portions of the building should be equipped with automatic sprinklers, including elevator shafts and stair towers. Openings into elevator shafts should be protected by standard fire doors hung with approved hardware.

Summary: Unsprinklered portion and defective sprinkler head.

11302. June 19, 1911. Woodworker. The dry kiln in which fire started was located on the fourth floor of the brick joist constructed woodworking building. There was a false ceiling above dry kilns, making a blind attic or concealed space under roof from one to two feet high. Fire spread in this concealed space above sprinklers, and destroyed the roof.

The building was equipped with an old type sprinkler system, installed in 1891. This was badly overloaded, but the old type heads had been replaced by Grinnell sprinklers in 1903, which were in good condition. There were about one hundred and ninety sprinkler heads per floor, the areas being well covered. All but twelve heads opened, but as sprinklers were below the false ceiling, they could not reach the fire.

Fire occurred at 2 p. m., being discovered by employees. Alarm was telephoned to fire department. The cause of fire and place where it started is unknown, the employees first seeing smoke rising from the corner of dry kiln. It however probably started in the concealed space above the dry kiln or in the dry kiln and worked its way into the blind attic, where it burned in the concealed space.

No private efforts were made to extinguish the fire on account of the dense smoke. The public department responded promptly and used twenty-six hose streams on the fire. The roof being of light construction, with the fire in the concealed space, made it difficult to reach the flame. Fire burned the roof off before extinguishment and caused heavy water damage on stock, machines and belts on floors below.

The unsatisfactory work of the sprinklers was due to fire burning in the concealed space where water from sprinklers could not reach it. Loss approximately $25,000.

Summary: Concealed space rendered sprinklers ineffective.

Miscellaneous Fires.

Interesting fires are given under this heading without regard to their classification.

H-4336. Flour Mill. Fire, believed to be of incendiary origin, started in the small brick stable, from which it spread to the one-story frame warehouse connected to stable by an open frame covered loading platform; from warehouse to texas of crib elevator twenty feet distant, igniting same about forty-five feet above ground beyond reach of hose streams. Before siamese connection of fire department could be placed fire spread across the one-story section of mill situated between and connecting elevator and main mill, a distance of forty feet, entering the fifth floor of the main mill building. From this point all remaining buildings were ignited, the resulting conflagration proving beyond control of the entire available city fire protection equipment.

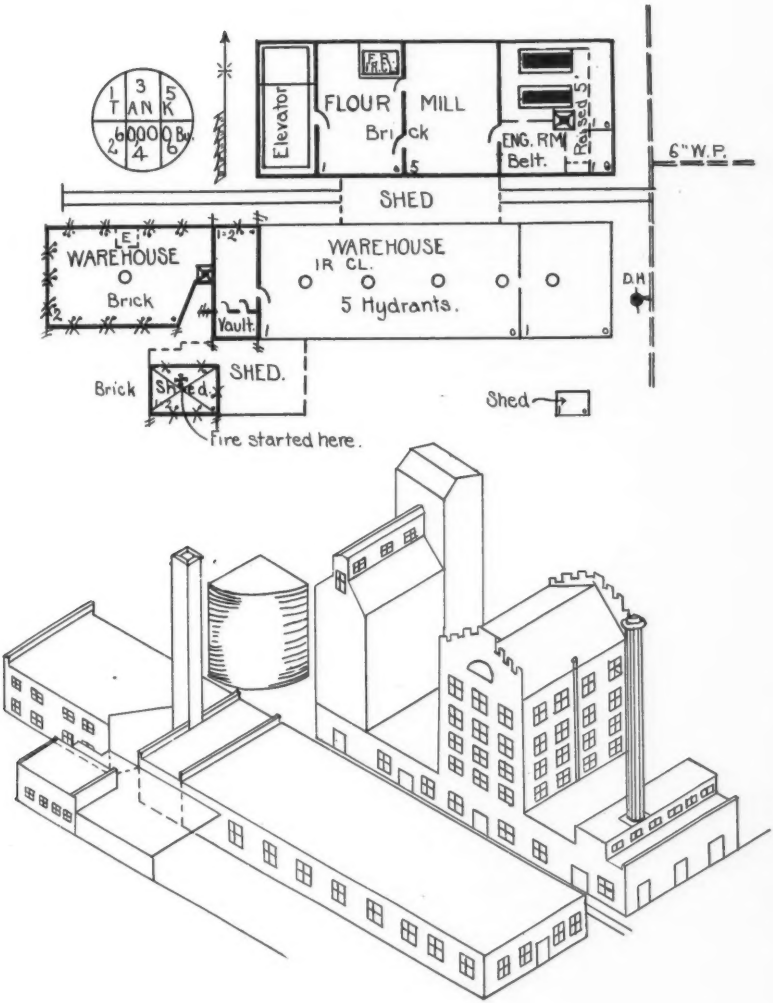
Buildings were of the ordinary frame, and brick and frame construction (see plan), with unprotected vertical openings, the horizontal openings being protected with double non-standard tin-clad fire doors which were of little value. Some of these doors were found after the fire with the woodwork entirely burned out. Investigation showed the tin work, although appearing to be standard, to be insecurely nailed at the joints, not properly jointed, and the heat bulged the sheets, forcing them apart, with the above results.

Plant was in full operation at time of fire, the usual watchman being off duty.

Fire was discovered by employee at 3 a. m. well under way in stable. Alarm was immediately given and public fire department responded, having hose streams in service in about ten minutes.

Buildings were practically a total loss, all walls being down above the first story and all woodwork being consumed. Fire department was in operation until 6.30 a. m., then recall was sounded, leaving four companies, twenty men, on the ground all day.

The particular point of interest in connection with this fire is the effect of heat upon the steel storage tank situate about twenty-seven feet distant from elevator. Tank was forty-five feet in diameter and forty feet high, subdivided into six sections, holding approximately 10,000 bushels of grain each when filled. Partitions were constructed of two by six inch timbers laid flat and spiked together, being secured to the outer steel shell by tie rods and bolts.



Miscellaneous Fire No. H-4336.

The steel boiler plates comprising tank showed the effects of intense heat by the warped condition, except at northwest side which was unexposed. The interior frame partitions were ignited through the steel at east side and burned out to a height of twenty-five feet from ground. The loss on grain was heavy upon bins numbered five and six on plan, the remaining sections suffering loss from smoke, heat and "sweating."

This tank was protected by a perforated one and one-fourth inch pipe on exposed sides, connected to a one and one-half inch riser, supplied by city water. A test of a similar arrangement on a duplicate tank proved that the amount of water delivered was scarcely sufficient to wet sides of tank, and device was of no value, as was proven in this case.

The wooden crib construction added materially to loss on grain in steel tank on account of heat and smoke damage to the grain; partitions ignited at a distance of twenty-seven feet through the steel plates.

The total destruction of this plant can be charged to the large buildings of brick and frame construction, adjoining and communicating, no standard cut-offs, and lack of efficient private protection. The most efficient protection in properties of this nature is a standard automatic sprinkler system, properly installed and maintained. Loss approximately $150,000.

H-4468. Fertilizer Factory. Fire was discovered by watchman after completing his rounds from 1.45 to 2.15 a. m. Watchman states that he went back into factory and discovered smoke issuing from behind a large pile of ammoniated phosphate base in northeast corner of building, and that he did not detect any odor or any evidence of fire when making round just previous. According to records and watchman's statement he was in factory twice in thirty minutes previous to the time that fire was discovered.

Buildings burned were factory, shed from factory to wharf and small hoist house on wharf. Factory was occupied for manufacture of wet mixed fertilizer.

The above-mentioned buildings and machinery therein were entirely destroyed. Stock appeared to be damaged about thirty per cent. At time of fire stock in factory was about as follows:

About fifty tons ground phosphate rock, 102 tons acidulated fish scrap, sixty tons wet hair, seventy tons garbage tankage, 105 tons potash manure, one ton muriate potash, three tons nitrate soda, five tons sulphate ammonia, 2,500 tons extremely low grade ammoniated super-phosphated "base" goods and twelve tons completed fertilizer.

No definite theory has been advanced as to cause of fire. The watchman stated that he believed fire originated outside of the building, his reasons being that he had, within ten minutes previous, been over and near pile of wet mixed base, behind which fire was first seen, and did not detect smoke or fire; he also believes, from the rapid progress which fire made, that building was fired from outside or burned through the frame

wall, although he stated that he did not see any fire either on outside or inside of buildings ten minutes previous and did not detect smoke or odor during rounds consuming thirty minutes; he further claims that on his regular rounds he was in sight of place both outside and inside of building where fire started. From watchman's account fire was first seen in northeast corner of building, between the frame wall and a pile of about 2,000 tons of wet mixed ammoniated super-phosphated base material. He attempted to extinguish fire by damping floor with pails of water, but on account of dense smoke and fumes had to abandon his efforts there, then going to floor below. He was soon compelled to leave building, as fire was gaining headway very rapidly. Shortly after flames seemed to burst out from entire side of building. Wind was blowing moderately at the time.

In absence of any definite information as to whether fire originated outside or inside of building, and judging from description of fire, as spreading very rapidly after bursting into flame, it would seem probable that fire originated from spontaneous combustion of some substance between the pile of wet mixed base and frame side of building.

There is a possibility that some of the organic ammoniates used were not thoroughly acidulated in this "wet mixing" process, or remained in a state in which they were susceptible to spontaneous heating, resulting from decomposition. Then, again, there probably was an accumulation of carbonized cellulose matter between this pile of wet mixed base and the frame side of building, there being a considerable amount of foreign cellulose substance together with the usual prevailing cellulose matter in the organic materials used as sources of ammonia in this pile of wet mixed base, and which was charred or carbonized by the action of the sulphuric acid.

It is probable that owing to the difference of specific gravities of the bodies in the wet mixed base material, when dumped on the pile a large proportion of the carbonized or lighter substances will roll or slide down sides of pile; one side of this pile in question was formed against side of the building and exerted such pressure as to bulge the frame wall out about ten inches before shrinkage in the pile took place, after which there was a space between the pile and the frame wall of building.

In case of a sufficient accumulation of carbonized cellulose matter on the side of pile next to frame side of building, it is very probable that at this side near the bottom of pile the contained heat, supplemented by the long continued chemical reactions further augmented by the pressure of pile, caused the accumulated carbonized particles to react on the phosphoric acid, the resultant action being to reduce a part of the phosphoric acid to phosphorus. As long as the pile were not disturbed where the reaction has taken place, there would be no ignition. But should the pile be disturbed, as when it becomes cracked through internal expansion and subsequent shrinkage, air is thus admitted and its contained oxygen attacks the particles of heated phosphorus, with probably considerably increased heat. If the pile of wet mixed base be in contact with side of house or

surrounding wooden posts, as in this case, shrinkage will cause an air space where oxygen is admitted and combustion begins in the pile and extends to the posts or woodwork. Either of the two conditions above mentioned could result in a fire or the two combined would greatly tend to increase probability of fire resulting from spontaneous ignition.

Information was refused as to the exact materials and the proportions used in the "wet mixed ammoniated base," the owner claiming the process secret and patented. It is believed, however, that about equal parts (say about 1,000 pounds of sulphuric acid and ground phosphate rock) are mixed in the mixing pan with 1,000 pounds of one or more ammoniates, such as hair, garbage tankage, acidulated fish scrap, or any other ammoniate desired.

There is a possibility that the amount of ammoniate base in this particular case might have had a bearing upon the hazard owing to the presence of the organic ammoniate in such proportions, which under certain conditions can produce free phosphorus and subsequent ignition or glowing in the pile, etc. Then again, in cases where there is a double combination of matter subject to decomposition and consequent heating up, especially when the material is in contact with the sides of the building, the conditions are ripe for a fire.

This fire serves to call attention to the following: 1. The importance of good watchman's service. 2. The value of adequate private fire protection. 3. The probable danger of fire from large piles of wet mixed ammoniated base when in contact with woodwork. 4. The constant danger to be expected from storage of garbage tankage and other organic ammoniates where containing excessive grease or moisture content and not properly stored to insure proper aeration.

Loss large.

H-4473. Omnibus Mercantile and Dwellings. Building was the result of remodelling several small brick and stone buildings into a block, carrying the walls out to street line, the old stone and brick walls entering into construction of block. The general construction consisted of double floors laid on ordinary joists, with metal ceilings in storerooms and wooden lath and plaster above first story. The building was four stories and basement in height with one high story addition in rear. The exterior and interior walls were of stone and brick, the interior walls in no way acting as fire walls, being pierced with large unprotected openings. The halls and stairways were open from basement up, also one freight elevator from basement to second floor.

Building was occupied for stores on first floor, storerooms and flats second, business college and flats third floor, five flats and large open attic fourth floor.

The fire started in the storeroom of the furniture store at 7.35 a. m., apparently in a pile of new furniture in its original wrappings of excelsior and paper, located about fifteen feet from freight elevator. Fire immedi-

Miscellaneous Fire No. H–4473.

ately spread into elevator shaft and to other wrapped furniture stored here, being mostly chairs. When discovered by employee the blaze was small and was in the wrappings on the back of some chairs. Cause probably smoking. Employee tried to extinguish fire with a chemical extinguisher, but it almost instantaneously spread and alarm was sent in to fire department.

Large quantities of excelsior had been dumped into basement at the bottom of elevator shaft, and this added greatly to the spread of the fire.

Fire department had hose streams on fire in about eight minutes. General alarm was sounded and ten hose streams were used, supplied by two fire engines and from city mains under direct pumping, the waterworks maintaining about ninety pounds' pressure throughout the fire.

Fifteen minutes after the fire started it was breaking out through the second story and soon found its way to the large hallway directly above, and in an incredibly short time had reached the roof and spread rapidly through glass and pine partitions to all parts of the two upper stories. The fire department devoted all their attention after the first twenty minutes to preventing the spread of fire to the surrounding buildings on the north and west sides. Fifty-five minutes after the fire started the front wall fell in, and within an hour and a half the building was consumed and most of the walls were down.

The flimsy construction, inflammable contents, unprotected floor openings, the large amount of loose excelsior at the bottom of the elevator shaft, were all conducive to the rapid spread of fire, which was evident throughout its duration.

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Several small fires were started on dwelling-house roofs from two to four blocks from the fire, and in one instance partly destroyed one dwelling. Snow fell throughout the forenoon and kept the roofs wet, this undoubtedly preventing a general conflagration. The fire was confined to the block, although unprotected openings in the adjacent block were exposed directly across a five-foot court. An examination of various metals show that at times a temperature of 1800° F. was reached.

The very rapid destruction of the block brings out the necessity of adequate building laws to prevent the construction of such lightly constructed buildings in the business section or for dwelling purposes.

H-4647. Coffin Factory and Supplies. Building was of slow-burning construction, twenty-six feet front by seventy feet in depth, and six stories high. Owners were an old business house and finally had this building especially built for their occupancy. A sprinkler tank had been erected on roof preparatory to the installation of automatic sprinklers, and windows equipped with metal window frames and sash glazed with wire glass. Building was occupied for lining burial caskets and some little wood finishing was done. Together with this was the making of shrouds, canopies and other articles for funeral use, also upholstery trimmings. The fire originated on the fourth floor, which was used entirely for the storage of finished caskets, trimmings and raw stock. In this room were stored six thousand pounds of dyed cotton yarns of various colors. The yarns were stored in bulk, some in bins, while some were piled on the floor.

Miscellaneous Fire No. H-4647. (See Frontispiece.)

Effect of severe exposure of wired glass windows from fire inside building.

The room was lighted by electric incandescent lamps, which were suspended in the passageway, being clear of all inflammable material. A short time previous to the outbreak of fire an odor of smoke was detected, but as

no person worked in the storeroom little attention was given to the odor until fire was seen. It spread so rapidly and was accompanied by such dense volumes of smoke that it was with difficulty that some of the employees on the top floor made their escape, and it was not until failure of some of the women to return to their homes that it was known that loss of five lives had resulted. The interior of the building above the second floor was destroyed.

The photographs reproduced with this report show the effect of the intense heat on the wired glass windows. The results cannot be taken as a criterion for judging the fire-retarding value of wired glass for moderate exposure, as the conditions obtained were abnormal from the interior fire, although it does substantiate the fire protection engineer's opinion that wired glass in approved metal frames is good only for moderate exposure.

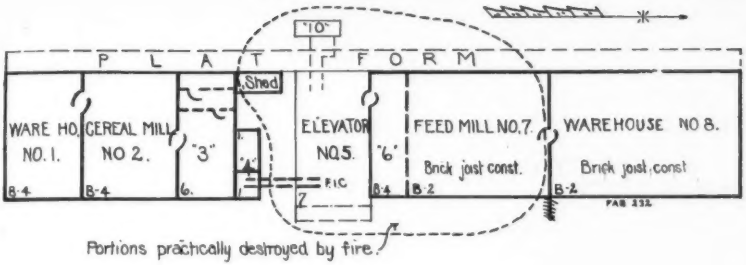
H-4701. Cereal Mill and Grain Elevator. Fire occurred in the frame iron-clad elevator No. 5, and the brick joist constructed feed mill No. 6 and No. 7 at 7.52 p. m. from a severe dust explosion. Cause of explosion unknown. Elevator No. 5 was seven stories high, with crib constructed bins; wooden elevator legs and fair joist floors. Feed mill No. 6 and No. 7 was four stories and basement high at No. 6 and two stories and basement at No. 7, with fair joist floors and stairs automatically trapped.

Alarm was given by employees after explosion. Watchman passed through burned building about fifteen minutes before fire and saw no signs of fire.

As to the cause of fire, it is probable that nothing definite will be ever learned, as four of the men present lost their lives and two were seriously injured.

The fire was very severe and the elevator and the brick buildings were practically destroyed, including a major portion of the contents. The force of the explosion was so great that people in dwellings in neighborhood were knocked down. The force of the draft came through the tunnel between No. 3 and the elevator, and almost tore a fire door from basement wall at No. 3 and No. 2 section, also came out of the other tunnel to loading platform or shed No. 10, injuring three men, burning two severely.

The fire doors at No. 8 building were of material aid in keeping fire from this section. The doors next to fire were heavily charred, the first two plys of wood being charred almost completely, but the remaining ply away from the fire remained intact. The double locked tin joints were fairly well made, but the bellying of the tin covering at center caused by the gases of combustion inside, tore two or three joints apart. These doors were knocked from their places when the elevator fell, the tracks however remained in place although considerably warped; the doors on side of wall away from fire were only slightly damaged. This demonstrates the value of double standard fire doors. The damage in No. 8 building was mainly water damage to feed, etc., in bags. The wired glass windows and fire door on the top floor of No. 3 building were said to have been of service



Miscellaneous Fire No. H-4701.

in assisting fire department in keeping fire from spreading into building. A considerable amount of water damage resulted in the basements of No. 1, 2 and 3.

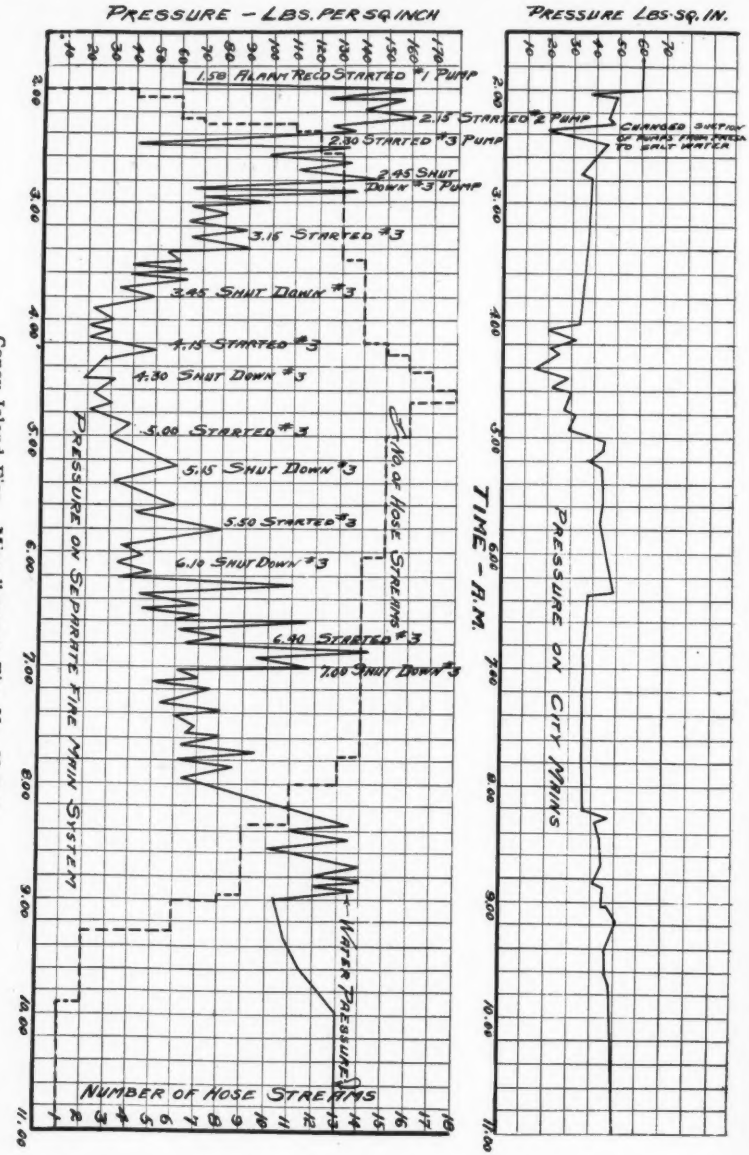
Approximate loss $75,000.

H-6353. Dreamland Amusement Park. The fire started in Dreamland Park in the two-story frame structure known as "Hell Gate," an amusement feature having channels through which the boats floated. These channels had leaked and were being covered with felt and pitch. The pitch was heated outside the building. Work was carried on at night by a temporary lighting outfit consisting of a cluster of electric lights on a wooden board. At about 1.45 a. m. the men discovered that the wooden back of this cluster of lights was afire. In the excitement it communicated to a pail of pitch standing nearby, and almost immediately the whole structure was ablaze. The men escaped from the building and attempted to fight the fire with hose streams until it had gained great headway. An alarm was then sent in after losing valuable time.

The firemen on their arrival found the fire under good headway and were unable to get it under control. The buildings were all of light frame construction, except the Dreamland Power House. The narrow walks between the buildings furnished neither resistance to the spread of the fire nor opportunity to fight it effectively. The fire burned northward and eastward, destroying the entire block between West 5th and West 12th Streets, Surf Avenue and the Atlantic Ocean, with the exception of one scenic railway between Henderson's Walk and West 12th Street.

The principal feature of interest in connection with this fire was the apparent failure of the separate fire main system. The system consists of 16-inch mains on West 15th Street and Surf Avenue with 12-inch laterals covering the amusement section of the Island. The hydrants have three 2½-inch outlets and those on 16-inch mains have an additional 4½-inch outlet for steamer connection; all outlets have independent gate valves.

The pumping plant located on West 15th Street, near Coney Island Creek, consists of three Gould triplex double-acting pumps, each designed


PRESSURE – LBS. PER SQ. INCH
PRESSURE LBS. SQ. IN.
1.58 ALARM RECD STARTED #1 PUMP
2.15 STARTED #2 PUMP
2.30 STARTED #3 PUMP
2.45 SHUT DOWN #3 PUMP
3.15 STARTED #3
3.45 SHUT DOWN #3
4.15 STARTED #3
4.30 SHUT DOWN #3
5.00 STARTED #3
5.15 SHUT DOWN #3
5.30 STARTED #3
6.10 SHUT DOWN #3
6.40 STARTED #3
7.00 SHUT DOWN #3
CHANGED SUCTION OF PUMPS FROM RESD TO SALT WATER
PRESSURE ON SEPARATE FIRE MAIN SYSTEM
NO. OF HOSE STREAMS
TIME – A.M.
PRESSURE ON CITY MAINS
WATER PRESSURE
NUMBER OF HOSE STREAMS

Coney Island Fire. Miscellaneous Fire No. H-5353.

to deliver 1,500 gallons per minute at 150 pounds pressure. Each pump is driven by a 3-cylinder four-cycle 175 H.P. gas engine. Suction from Coney Island Creek (salt water), or from 12-inch low service mains (fresh water). The engines run on illuminating gas supplied by 6-inch main from the gas house of a private company nearby, with a 3-inch connection to each engine. Engines are started by compressed air. It is stated that the action of the gas engines is exceedingly reliable and they seldom fail to pick up their load the first time they are turned over. Each pump is operated once a day, discharging through an 8-inch relief valve.

Working of the Pumping Station. The first pump was started at 1.58 a. m. and raised pressure immediately to 160 pounds. The second pump was started at 2.15 a. m. These two pumps worked satisfactorily during the entire time of the fire. The third pump was started at 2.30, but was shut down at 2.45 on account of a hot bearing. Subsequent attempts to use this pump were made at 3.15, 4.15, 5.00, 5.50 and 6.40 a. m. At each trial it ran from fifteen to thirty minutes before overheating.

The water pressure and number of hose streams supplied by the separate fire main system, of which there is definite record, are shown in the accompanying chart. The number of streams given is probably less than the actual number in use. Some of the amusement resorts which had access to the separate fire main hydrants were also using streams to wet down their property. The largest number of streams in service at one time is variously estimated from thirty to forty-seven. Another circumstance contributing to the poor showing of the pumping plant was the attachment of steamers to hydrants on the separate fire main system. The records indicate that three steamers were connected in this way.

Conclusions. The spread of this fire was due in part to delay in turning in an alarm and the inflammable nature of the buildings. The large area without fire walls or customary streets of proper width made it an exceedingly hard fire to fight. The separate fire main system was called on beyond its capacity and its use was not restricted to the fire department, but the minimum pressure would have been somewhat higher if the three pumps had remained constantly in service.

Recommendations. The capacity of the pumping station for the separate fire main system at Coney Island should be increased at least 100 per cent. It is understood that plans providing for an increase in the capacity of the station are already under consideration.

Pumps should be run long enough during the daily test to show if the bearings are overheating.

9923. Coal Tar Distillery and Manufacture of Tarred Paper. Fire apparently started on the upper frame work of a paper saturating machine at 9.30 a. m. while it was in operation. This machine consists of a steam-heated tank containing the coating materials through which the felt paper is forced to pass by means of a rack which drops and depresses the sheet

of paper into the tank as it passes from the uncoated roll on one side of machine to the roll of coated product on the other side. This rack is supported by an iron framework over machine.

Coating material consists of a heavy coal tar oil, produced by the fractional distillation of coal tar, and containing impure carbolic acid, creosote, anthracene and naphtha. This liquid will not flash at ordinary temperature, but gives off inflammable fumes at the temperature at which coating is carried on.

Fire first appeared on the frame which supports the rack and the whole machine burst into flames, extending to the roof 25 feet above and setting fire to same. Owner states the contents of the tank containing the coating material did not take fire, but that fire appeared to be around and on frame of machine, except as it ignited roof.

Building was equipped with Grinnell glass disc sprinklers on dry system, modern 1-2-3 pipe sizes and spacing. Primary supply from gravity tank 12 pounds pressure, second supply from two 500 gallon rotary pumps. These pumps were of great value, supplying sprinkler system and hose streams. Fifty-two sprinklers in all opened.

Engineer happened to be in yard just as flame burst through roof, and ran to power house and pulled private fire alarm. No one seems to remember when the sprinkler alarm first operated, but it was said to have operated all right. The private brigade took their stations at once; from all accounts pumps were started in a little over a minute and the whole fire handled most effectually. Streams were taken from two yard hydrants and from roof standpipe. Pumps ran at from 80 to 100 pounds pressure. Fire was under control when city department arrived. The heat must have been very intense to have opened the 52 sprinklers, some 60 feet from origin of fire. Damage by fire was slight, possibly not over ten per cent, with a slight water damage, principally to finished product.

S-9494. Car Barn. Car barn was one story in height, 80 by 125 feet in area, of brick construction and divided longitudinally by a fire wall and by a center cross wall into four divisions. Roof is gable shaped, slate on two-inch pine, on steel purline and trusses resting on steel columns inside of side walls, cinder floor. The building is protected with an approved automatic dry-pipe sprinkler system, having aisle and ceiling sprinklers. The water supplies consist of a 40,000 gallon gravity tank, siamese steamer connection, and six-inch connection with city main. The city pressure is about 65 pounds. The building is also equipped with hand chemicals, fire hose, watch-clock system and an annunciator system in connection with the sprinkler equipment. Each full section of building has a trackage for the accommodation of forty-five cars.

At 12.30 a. m. the night employees were startled by the ringing of the sprinkler gong at annunciator. The employees armed themselves with chemical extinguishers and hurried to location indicated by the annunciator. They found a car burning in the southwesterly section of the car house and

two aisle sprinklers operating. The sprinklers had the fire well in check, but the employees extinguished the embers with hand chemical and small hose. The loss amounted to $644. The fire was caused by an overheated stove, which was located in the front end of the car. The flames spread through the vestibule and side windows, opening one aisle sprinkler on either side of track. When the employees arrived these sprinklers had already checked the progress of the fire, and would no doubt have completely extinguished it had they waited for this result. This fire demonstrates the value of aisle sprinklers in car houses, also the value of a sprinkler alarm system and hand fire appliances. In a car house with a high ceiling a fire of this nature, no doubt, would result in a greater damage without aisle sprinklers.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

H-6230. Foundry. Fire occurred in storehouse occupied for the storage of patterns and for dipping metal parts in asphaltum. The asphaltum tank was heated by an open gas flame. Drippings from stock hung up to drain are supposed to have dropped into or near the gas flame and ignited. Fire was confined to the vicinity of the dip tank by the public fire department.

Asphaltum dip tank should have been steam heated, eliminating the need of the open gas flame.

H-6359. Gas Plant. Explosion and fire occurred from the electric lighting system in the gas purifier house. The explosion is thought to have been caused by the turning on of an incandescent electric light, the spark in the socket igniting the gas in the room. The purifier house was practically destroyed.

In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe and supported on a pipe hanger wired with approved rubber covered wire soldered directly to the circuit.

Switch controlling lights must be located outside of room where there is no liability of inflammable gases being present.

H-6361. Chemical Works. Fire occurred at 4 a. m., caused by the boiling over of a kettle of rosin through lack of attention on the part of the watchman. The kettle was heated by a coal fire.

Rosin kettle should be heated by steam.

Watchman should devote his entire time to watching plant.

H-6369. Electro-plating Works. Fire was caused by the careless disposal of waste which contained lint from the buffing wheels.

Lint from buffing wheels is susceptible to fires from sparks and spontaneous ignition. It should be blown to an outside dust vault or gathered in an approved waste can and removed from building or burned each night.

H-6399. Pipe Works. The burning of the asphaltum dip tank used for coating pipe, which was located in yard, severely exposed the frame storage shed.

The metal pipes are heated in a coke fire in the yard, well removed from the main buildings, and are placed while hot into a metal tank containing asphaltum paint thinned with benzine. This paint was ignited by a section of pipe which had been overheated. The asphaltum burned freely and soon ignited the shed.

H-6401. Printing Daily Newspaper. Fire immediately followed the opening of light switch on side of pit containing printing press. Possibly the arc from switch ignited the paper dust in air which flashed fire to the paper on press.

Switches should not be located where there is danger of the arc igniting dust or flyings in the air.

H-6423. Theatre. Fire occurred in the foyer at 10.50 p. m. as people were leaving the theatre. It was evidently caused by someone lighting a cigar and dropping the match on the carpet, or setting fire to the draperies while scratching the match.

H-6426. Naphtha Cleaning. Fire occurred while employee was cleaning a silk dress in a pail of naphtha. Dress was of silk with a woolen lining. The employee was rubbing the dress in the pail when a spark of static electricity ignited the naphtha vapors.

H-6451. Fertilizer Works. Sparks from dryer chimney ignited shingle roof at 1.30 p. m. It was thought that fire had been extinguished, but evidently some sparks were left smouldering under the shingles or in cracks in roof boarding, which were later fanned into blaze by the high winds at night, rekindling and totally destroying building and contents. Loss $40,000.

Building was without public or private protection and fire was allowed to burn itself out.

Shingle roof should have been replaced with non-combustible roof covering. Where property is without public or private protection the spark hazard is greatly increased, as a fire starting on the roof beyond the reach of water pails often means total destruction of the property, whereas if the blaze could have been reached in its incipiency it would have been

easily extinguished by a few pails of water. The spark hazard can be greatly reduced by equipping smoke-stacks with spark arresters and covering roofs vith non-combustible roofing.

A ladder reaching to roof permanently fixed to side of building and a supply of chemical hand extinguishers or a cask of water, and fire pails placed so as to be accessible in case of fire, are of great value in extinguishing roof fires and guard against sparks from exposure gaining a foothold on the roof. This arrangement is of critical value during the dry season.

S-10915. Cotton Mill. Fire was caused by the breaking of an incandescent electric lamp which caught in belt.

Lamps should be so arranged and guarded that they cannot come in contact with moving belts.

S-10953. Cotton Mill. Fire was caused by truck running over a match on the floor, which ignited waste cotton nearby.

Prohibit the use of all but safety matches. Recent tests have conclusively shown that the modern safety match which can only be lighted on the prepared box will not ignite when stepped on the floor or when mixed with stock and subjected to beating in pickers.

S-10955. Piano Factory. Fire occurred in the dry room at 10 p. m. It was undoubtedly caused by the one-inch pipe which supplies live steam to the dry rooms. This pipe was in contact with the posts where passing up through building, and no collars had been provided where running through floors.

Steam pipes should have been secured at a safe distance from the woodwork with substantial metal supports. Where passing through floor or partitions, the woodwork should be cut away from piping not less than an inch and the annular space filled with asbestos or other non-combustible pipe covering.

S-11039. Cotton Mill. Fire was first seen near the top of a pile of cut goods in bins in the cutting room. It was evidently caused by an electric lamp in contact with the inflammable material.

Electric lamps should be protected by substantial wire guards where there is danger of their coming in contact with readily ignitible material. The lamp bulb frequently becomes hot enough to ignite paper, cotton or similar inflammable material, and should be safeguarded.

S-11051. Silverware Manufacturer. Fire was caused by a discharge of static electricity igniting vapors from benzine tank. The boy who was working at the benzine tank placed his hand on a bench over four feet from the moving belt which probably gave off the spark, and put the other hand, in which he was holding a piece of waste, into the benzine tank. There was instantly a flash of fire which must have been caused by the

discharge of static electricity through the boy's hand to benzine tank. The boy had no time to try to put the cover down on the tank as the waste stuck to his hand and in trying to pull it off was severely burned.

The tank cover was automatic and closed, entirely extinguishing the fire in the tank.

S-11095. Rubber Mill. Fire started in the rubber spreader and instantly spread all over the machine, badly burning the two operatives in the room and causing a great deal of heat and dense smoke. Thirteen sprinklers opened and the water from these floated the burning cement and coating mixture about the floor, setting fire to a table nearby, and burning the insulation on the electric wiring. There was no fire door at the opening in the wall between this room and the spreader room next to the east and the burning liquid was spattered or floated into this room, opening three heads here also.

The principal damage was to stock in process in the spreader rooms where balloon cloth and æro cloth was being made, and some compounds and stock in the mixing room which were damaged by water from a hose stream. The mill employees laid four lines of hose, but showed good judgment and only used one stream. The city fire department used hand extinguishers only. The fire pump being under governor ran during the fire and no defect was apparent in the water supply. The floors were amply drained and the water was quickly carried outside the building.

The fire teaches the following lessons:—

(1). Openings in the division walls between rooms containing such hazardous processes as are here carried on should be well protected with approved automatic fire doors.

(2). Electric wiring in hazardous rooms should be in conduit; lamps should be in vaporproof globes, and all pendant and portable lamps should be wired with heavy reinforced flexible cord. A safer arrangement would be to light the building with lamps in reflectors outside the windows.

(3). Ample floor drainage is important in rooms where volatile liquids are used.

(4). A static collector should be provided on each spreading machine and it should be well grounded on a water pipe.

S-11098. Woodworker. The fire occurred in a pile of sawdust which had accumulated on the tin roof from a leak in the sawdust blower system. This was undoubtedly ignited by a spark from a nearby boiler stack. The fire heated the tin and ignited the joist roof before being discovered by employees.

S-11104. Locomotive Works. Fire started in the second story of boiler shop at a fuel oil rivet heater—of the portable combination fuel oil tank and furnace type. The oil tank has a capacity of about thirty gallons, and this is under air pressure.

Fire was caused by a defective oil valve, or cock, which allowed the oil to escape from the tank. This was ignited at the furnace and was sprayed by the air pressure in all directions, setting fire to the woodwork, also to workmen's clothing, injuring ten or twelve men, two fatally.

Fifty-one sprinklers opened and controlled fire until arrival of private brigade.

Apparatus using fuel oil, however safeguarded, introduces a distinct hazard into the building. A system of the above type not only is hazardous from fire but also to life, and should not be installed. Under approved installation the maximum amount of fuel oil allowable inside the building is ten gallons. Oil must be fed from the supply tank to burners by an approved system of duplicate pumps, and system should be arranged so that oil pressure cannot at any time exceed sixty pounds. Fuel oil may also be fed to burners from a standpipe of ten gallons capacity. Both systems must be arranged so that surplus will drain back to supply tank.

No apparatus is suggested or listed for the use of fuel oil in portable furnaces or where oil cannot be drained back to supply tank.

S-11112. Mercantile. Painters who were redecorating building wadded up some linseed paint rags and threw them into a corner. Rags ignited spontaneously in about twelve hours. One sprinkler opened and extinguished fire.

Linseed oil is very susceptible to spontaneous ignition. All linseed oil or paint rags should be placed in approved metal waste cans and removed at night and burned.

S-11126. Tenant Manufacturing. Fire was caused by a painter who was cleaning his paint brushes with benzine near a kerosene oil lamp.

Benzine vapors have the same vaporizing and explosive characteristics as gasolene and should be safeguarded in a similar manner. Benzine should never be used, even in small quantities, in the presence of open lights. Fire has flashed to container through the medium of its vapor from over fifty feet distance.

S-11132. Manufacturing Plumbers' Supplies. Fire was caused by spontaneous ignition of oily waste in the pocket of workman's overalls. Fire spread to wooden racks above, opening two sprinklers, which entirely extinguished the fire.

All oily material should be kept in standard waste cans.

S-11133. Tenant Manufacturing. Fire occurred between the brick arched ceiling of boiler room and the joist constructed roof. The roof rested directly on top of the brick arch ceiling, which was about two feet above the tops of boilers. Arches were not tight, and allowed heat to bank up in the concealed space above, which probably became excessive and ignited the woodwork of roof.

Brick arch over boilers should be made tight and boiler room ventilated to carry off the excessive heat. Woodwork of roof should not rest

directly upon the brick arch. Where brick-work is exposed to constant heat it soon approximates the temperature to which it is exposed, and in many instances has ignited combustible material on shelves or piled against it.

S-11166. Shoe Factory. The fire occurred just after the plant had started up in the morning. There was a long row of electric heated treeing machines located on the east side of the room and one or two on the north end. They were all wired in parallel on a 110-volt circuit, run on the ceiling of the floor below, properly fused at the main switch and each machine controlled by a properly fused switch. Sometime ago the end machine on the line, located in the middle of the north side, was removed and the wires cut off about twelve inches above the floor and left without taping or protection. The morning of the fire an employee came in from the cement house, where the naphtha is kept at night, with a five-gallon safety can of naphtha. He filled a small open pan, holding a pint or so, at the place where the loose wires were and then set the pan down on these wires. This short circuited the line either through the pan or by the two ends coming together, and the ensuing arc ignited the naphtha vapors. The large can ignited almost immediately. Four sprinklers opened over this spot. Employees used powder extinguishers and by means of broom handles attempted to throw the large can out of the north windows. Windows opened rather hard and, instead of smashing them, they carried the blazing can across the room to throw it out the west windows, opening two more heads on the way.

The fire was easily extinguished, the fire department arriving after it was controlled.

There was little damage by fire, the principal loss being by water from the sprinklers to finished shoes on the floor below.

Wires should have been disconnected on ceiling below and the junctions taped and insulated in an approved manner. Should this not be feasible the ends of wires should be taped and protected by porcelain bushings in such a manner that wires could not come in contact with each other or be short circuited.

S-11168. Hosiery Mill. Fire was caused by the arcing of a defective electric light cord which ignited the fly on cord, fire spreading to ceiling.

The flexible cord in pendant lamps is subjected to much hard usage as a result of constant handling and bending, and the chances of short circuits are considerable on account of the two wires of opposite polarity being brought so near to each other. Only approved cord should be used and lamps and cords should be frequently inspected to see that no breaks are occurring in the insulation.

S-11173. Lace Works. Each lace machine is equipped with an incandescent electric light, hung over the beams so that the operation of the machine can be closely watched. Beams are also protected by a cloth which is placed over same to prevent lint, dust, etc., from falling upon the

thread. In some way the electric light globe was broken, and when the current was turned on the sparking ignited the lint and dust on the cloth cover. Fire was quickly extinguished with pails of water and brooms.

Lamps should be protected with a substantial wire guard to prevent their being broken or coming in contact with the inflammable material on lace machine.

S-11185. Printing Plant. Fire was caused by the overheating and charring of flooring and joists under stereotype furnace. A large coal heated furnace was located on the top floor of printery, insulated from the floor with asbestos, and the floor metal-clad on all sides.

Stereotyping furnaces should be set on non-combustible floors. If not located in the basement, they should be set on concrete or brick arches sprung between steel I-beams. In old buildings where this is not feasible a safe foundation can be made by covering floor with sheet metal of at least twelve gauge, on which should be laid four inches of brick on edge with cement mortar and over this four-inch hollow tile with continuous ducts running the short way. All rubbish and inflammable material should be kept away from furnaces.

S-11192. Furniture Factory. Fire occurred in the shavings house during the noon hour. Employee shut down fan in shavings blower system for the noon hour but did not disconnect feed pipe to boiler furnace. Sparks from boiler furnace ignited shavings in feed pipe, spreading fire into shavings vault.

S-11193. Manufacturing Paper Bags. Fire was caused by the blowing of a fuse. When the electric lights were switched on just before starting up at 7.20 a. m., a modern type of cartridge fuse in plug block blew out from unknown cause, igniting the paper sheathing on ceiling.

Fuses should not be placed where there is a liability of their igniting combustible material should they operate.

Where it is necessary to sheathe ceiling to prevent dust from falling from floor above, non-combustible sheathing should be used.

S-11211. Department Store. Fire started in the brick and tile roof house containing motor and blower for ventilating system. Blower was driven by a wooden pulley bolted onto blower shaft and depending on friction to hold it tight on shaft. Pulley dried out and became loose on shaft, the resulting friction soon igniting pulley.

All wooden pulleys should be lined with metal sleeves and keyed to shaft.

S-11217. Metal Worker. Fire was evidently caused by the spontaneous ignition of painter's oily clothing hanging in closet.

Six automatic sprinklers opened at once and gave efficient service, preventing fire from spreading into a large japan dip tank quite near and the paint storage room a short distance away.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Alarm Service.

H-6361. Chemical Works. Watchman discovered fire well under way on the first floor while on his five o'clock round. Instead of closing the fire doors into the other sections of the building, he ran out to give the alarm, and by the time he returned the fire had spread into these sections. Fire doors were automatic, and claimed to have been in order a few days previous, but although automatic they failed to operate, and were still in place and open after fire.

It had not been the custom of the watchman to close these doors at night, as dependence was placed on the automatic device.

The buildings were entirely gutted, and only the walls remained standing.

Although fire doors are equipped to close automatically in case of fire, they should be closed each day at close of work. Many times fire will spread with such rapidity as to pass through door opening before heat is sufficient to melt fusible link, or before door can close automatically.

H-6448. Box Factory. Watchman discovered fire at 8.45 p. m., and supposed that he had given the fire alarm when he opened alarm box. In reality, he simply rang the bell in the cover of the box. Fire was later discovered and alarm sent in at 9.08 by men on fire boat who saw the blaze.

Watchmen should be instructed how to correctly give fire alarm.

S-10955. Piano Works. Watchman discovered fire in the dry room on his ten o'clock round, and immediately gave public alarm. Fire department responded promptly, and attacked fire with a hose stream from standpipe system, extinguishing the fire in a few minutes.

S-11216. Tenant Manufacturing Building. (Ladies' Hats.) Watchman heard alarm bells ringing, but took his time in locating fire. Tenant on third floor also heard bells, and locating fire, telephoned the fire department. Fire department responded at once, but sprinklers had been in operation for so long a time that it was impossible to prevent a heavy water damage. Loss, $12,850.

Had building been under the supervision of a competent night watchman and the alarm immediately investigated, loss would have been trivial.

Automatic Sprinklers.

H-6265. Rubber Works. The fire occurred under a large bench with tight wooden top forty feet long, three and one-half feet wide, used for painting hose, and under which were a few paints and oils, short pieces of suction hose, also oily waste or rags and probably some dirty overalls. This was due to carelessness of employees, as plenty of metal-covered cans are provided in room for waste, and a place provided for all oily clothing.

The fire extended the whole length of bench underneath, burning the material under same, and badly charring the legs and under side of bench. Fifteen sprinklers in all opened, and held fire entirely under bench. The paint on the wood partitions at each end of bench, which come within one foot to fifteen inches of it, was not even blistered, nor the bench alongside of it, about three feet distant.

S-10877. Cotton Mill. Fire occurred in a frame shed adjoining the waste house. The shed at time of fire contained twenty-four bags of waste which ignited from unknown cause.

The fire proved a severe exposure to the waste house, practically destroying the door and windows in side wall, and opening seven sprinklers. Sprinklers with assistance of hose streams were effectual in preventing fire from entering waste house. The wooden shed and part of the stock were destroyed, and in addition to the damage to the doors and windows of waste house, the wooden cornice was so badly burned as to necessitate replacing.

Window openings under moderate exposure can be effectually protected by using wired glass and metal frame windows.

S-11239. Woolen Mill. The fire was discovered by an employee working in the picker house at the time. Picker house was equipped with Grinnell "D" and International sprinklers on the 1-3-6 schedule of pipe sizes, supplied by waterworks at 115 pounds pressure. Sprinkler system, however, was shut off for the winter at time of fire. Employee at once gave alarm of fire to the engineer, who opened the gate valve to waterworks supply. The fire spread rapidly over the entire room, opening thirty-three of the thirty-six heads in the room. Sprinklers practically extinguished the fire with small loss.

Water supply to sprinklers should be maintained automatically in service at all times. In one hundred and twenty-eight fires, or twenty-three per cent of the fires where the work of the sprinkler system was unsatisfactory, it was due to the water being shut off at the time fire started. In some cases the water was turned onto system after fire was discovered, but the sprinklers were ineffective on account of the large number opened overtaxing the water supplies.

Eighty-one per cent of the fires on record occurring under automatic sprinkler protection were extinguished by ten or less sprinklers opening; thirty per cent by the opening of one sprinkler. In these cases the water

was automatic on sprinkler system, ready to be discharged the moment the heat from fire was sufficient to open sprinklers, extinguishing or checking fire in its incipiency with but small loss.

Sixteen of the one hundred and twenty eight unsatisfactory sprinkler fires were due to the water being shut off sprinkler system on account of danger of freezing. In the buildings or portions of buildings which cannot be protected from frost with reasonable precautions, dry-pipe sprinkler systems should be installed, making the system automatic, only retarding the water discharge from sprinklers a few seconds.

S-11281. Straw Hat Factory. Fire originated in a stock of straw braid stored on shelving on the fourth floor. Six sprinklers opened at once, but were unable to extinguish the fire on account of the serious obstruction to distribution from the double shelving, which was about four feet wide.

Chemical Extinguishers.

H-6241. Refined Oils and Petroleum Products. Fire occurred near still. Employee was pumping oil under heavy pressure when a stop cock burst, the spraying oil coming in contact with the open fire under the still and igniting. Fire was fought with hose and chemical extinguishers. The hose stream had but little effect on the blazing oil, but as soon as the chemical extinguishers were brought into service, the fire was soon under control.

S-11225. Cotton Mill. Fire was first seen near an overhead shaft hanger which projected into card room through a frame partition. Fire rapidly spread over lint on partition and over five of the wool cards, but was quickly extinguished through the use of twenty-six chemical fire extinguishers before sprinklers opened, thus saving the wetting of card clothing.

Construction.

S-10906. Carpet Mill. Floors were supported on double beams built up of planks on edge with a three-quarters inch space between. Two small cross beams had been inserted running between beams about half way between adjacent sprinklers on the same line. This pocket formed by the beams could not be reached by the water from the sprinklers, and the fire damage was greatest at this point.

Double beams are considered only one-half as efficient as heavy solid beams from the fire-resistive standpoint. They present twice the surface area over which fire can spread and a larger number of corners or projections which are easily ignited by fire. The three-quarters to an inch space between beams forms a concealed space in which fire can spread practically unmolested. In several cases after fire had been checked so that firemen could enter the mill, it has been necessary to go over all beams individually with chemical extinguishers or small hose and extinguish the fire still burning in these spaces between beams which could not be reached by sprinklers or hose streams. (See page 39.)

S-11000. Foundry. While the watchman was making his round at 8.53 p. m., he discovered fire in the core room in a pile of wooden boxes filled with small finished cores. He attempted to extinguish the fire with pails of water, but was unsuccessful and gave the public alarm. The fire spread into a storeroom filled with supplies and core boxes, and also ignited the plank roof, traveling lengthwise in each direction. At the westerly end it was stopped by the corrugated iron partition of repair shop. It burned up through the roof at the joints in the planking and along the lines of the trusses.

The core room is separated from the main foundry by a brick wall, pierced with large arched openings extending to within ten feet of the ceiling in every bay but one which is open to the ceiling. The solid upper part of this wall acted as a curtain wall and confined the fire to the core room except at the open bay where the monitor which runs across the main building was burned for about one hundred and fifty feet in length.

The damage to the building is as follows: The wooden roof of two-inch plank with tar and gravel covering was burned so that nearly all of it will have to be replaced. Some of the trusses were warped and a few of the steel columns were twisted, while the general expansion of the steel work started the rivets and gusset plates at points where the fire was not intense. This roof will have to be thoroughly repaired. The brick storeroom had a concrete ceiling on iron rails, the expansion of which wrecked the ceiling and cracked the walls. This room will have to be rebuilt. The window frames and sashes were destroyed for about half the length of the core room building and also in one monitor of the main building.

Unprotected steel work is more susceptible to damage and warping from fire than heavy timber construction. Steel columns and beams can be easily protected by covering with expanded metal and applying at least three-quarters of an inch of cement plaster. Main supporting beams or columns, however, should be protected with at least four inches of hard burned brick, terra cotta or concrete.

S-11119. Manufacturing Gasolene and Gas Stoves. Fire occurred on second floor in the fireproof gasolene burner testing room. The valve on a one-gallon testing reservoir sprung a leak, the gasolene igniting from the burner being tested. One sprinkler opened, but had little effect on the burning gasolene. The fire doors to room were closed and the fire burned itself out without injury to building.

S-11172. Metal Worker. Building was of open mill construction. Fire occurred on the third floor and was extinguished by two automatic sprinklers. Water from sprinklers ran through the lower floors, causing heavy water damage.

Floors should be made water-tight and equipped with scuppers to drain water outside of building.

S-11226. Linen Mill. Fire was first noticed in the cards. From cards it spread through dust flue to dust house, from which it was blown

into the filter house. The fire was most severe in the dust house. The solder on the galvanized iron lining of dust room soon melted and fire spread in between the iron lining and wooden frame side of the building, where it burned through the sides and roof.

The metal linings of dust rooms, stock bins, or other enclosures liable to be subjected to severe heat, should not be held together by solder. The lining should be held together by lock jointing and blind nailing. When nail heads are exposed to fire they soon heat and char the woodwork, become loose and allow the metal covering to spring from the woodwork.

Metal covering attached similar to the method of applying the tin covering to fire doors gives the greatest protection.

S-11300. Straw Hat Factory. (Tenant Manufacturing Building.) Fire occurred in the straw hat factory on the fourth floor. Four sprinklers opened and practically extinguished fire. Water from sprinklers ran through cracks in floors, causing water damage on all floors below.

Floors should be made water-tight and scuppered.

Fire Doors.

H-6452. Coffin Factory. Fire started in frame dry kiln adjoining main mill and not cut off. Watchman discovered smoke in the factory about midnight, but could not locate fire until he lifted the curtain between the factory and dry kiln. This gave a fresh supply of air to the smouldering fire in kiln and fire flashed over stock and kiln. Factory, kiln and contents were a total loss. Loss $27,000.

Had kiln been cut off from main mill by a standard fire wall and fire doors instead of opening being protected by a canvas curtain, fire would have been confined to the kiln.

Fire Escapes.

S-11126. Tenant Manufacturing Building. The building, which had just been constructed, was being finished at the time the fire occurred, and the tenant on the top floor was moving in. Fire occurred in the basement near the fireproof stairway.

Stairways were equipped with wooden doors. The doors in the basement and on first floor were open at the time of fire, converting stairway into a smoke-flue to roof.

There were about fifty employees, mostly women, on the top floor at the time. They attempted to use this stairway but were unable to reach the street on account of the smoke, and so had to return to the top floor and descend by another fireproof stairway. All doors in this second stairway were locked, except on the top floor, on account of the stairway and elevator nearby not being finished, and had fire occurred on any lower floor it would have been difficult, if not impossible, for tenants above to pass down stairs to street.

Practically the entire value of the fireproof stairway is sacrificed by the use of the unprotected wooden doors.

All openings into stairway should be protected by approved automatic fire doors. These should latch tightly but should not be locked.

Fire Pails.

S-11253. Printing and Bookbinding. Fire occurred among some printed book stock stored in wooden tills in the basement. Employees entering saw smoke and extinguished the fire with water from fire pails which were hanging several feet from fire. No sprinklers were opened.

S-11256. Celluloid Comb Factory. Fire was caused by the overheating of a celluloid comb blank which was left too long on steam warming table. Fire pails were used and so promptly extinguished fire that no sprinklers were opened and fire did no more than consume the one piece of celluloid which ignited.

Fire Walls.

H-6363. Saw and Planing Mill. Fire was first discovered over the boilers in the roof of boiler house. Boiler house was cut off from mill by a brick fire wall which prevented fire from spreading into main buildings. Boiler house was entirely destroyed.

H-6416. Paper Mill. Fire started from unknown cause in frame storehouse No. 6, spreading to building No. 3. Owing to the occupancy and light construction, fire spread with great rapidity, and in about fifteen minutes wall began to sag and portions of the roofs to collapse. Brick fire wall parapetted three feet between buildings No. 3 and No. 2 proved an effective fire stop and prevented the fire from spreading to other buildings in this direction. Other exposed buildings were saved through the use of hose streams.

Floor Openings.

H-6322. Chair Factory. Fire started on the first floor and spread to the second floor through an open stairway.

The fire hazard of the open stairways between floors can be greatly reduced by enclosing in frame partitions and doors. Partitions and doors should be the same thickness as the floors.

Gate Valves.

S-11285. Printing Establishment. On the watchman's regular 10 p. m. round he discovered the fire and the sprinklers operating, and notified another employee who gave alarm to the fire department by telephone. The fire department claim to have understood the call for a fire in an alley adjoining the building and not for a fire in the building. It was a coincident that the fire department on arriving should have found some packing boxes and waste material afire in the alley, and after putting this

fire out, thinking they had answered the fire call, were on their way back to fire house when an employee overtook the apparatus and had it return to the building. By this time it was stated the fire was out, but those present could not shut the water off sprinkler system, not being familiar with the sprinkler valves. The watchman had been on duty only a week or so and had never been instructed regarding the valves. In the confusion, an outside sprinkler valve was opened, with the result that considerable water was thrown into the upper floors.

The protection company was notified by telephone, but the first man to arrive was not familiar with the system and had to return to his office for help. In the meantime the firemen located the proper valve and shut off the water. The engineer was then called and the fused sprinklers replaced, putting the system in commission again.

Watchman should be fully instructed regarding private fire protection before the property is left entirely in his charge.

Signs should be posted giving the location of gate valves controlling the sprinkler system.

Obstruction to Distribution.

S-10903. Paper Mill. Fire from unknown cause occurred in baled waste paper stock warehouse. Three sprinklers opened promptly and held fire from spreading into newspaper stock nearby. They could not, however, extinguish the fire on account of the severe obstruction to distribution, bales being piled six high, fire burning under and between bales where water from sprinklers could not reach it. Fire department responded and extinguished fire with one hose stream.

The efficiency of automatic sprinkler protection is in proportion to the ability of the water discharged from sprinklers to reach and cover all places where fire might burn. Deep piles of bales or hollow goods allow fire to spread through the pile under and between bales where water from sprinklers cannot reach it.

Private Brigade.

Upon alarm of fire, employees manned the fire hose and soon had three streams from private hydrants on the fire. The hydrants were supplied by the large service pumps which are in constant operation. Employees did excellent work confining fire to the room in which it started and having it practically extinguished by the time the fire department arrived.

Private Protection.

H-6399. Pipe Works. Fire was caused by the ignition of an asphaltum dip tank located in the yard. The public fire department could do nothing upon arrival on account of the distance to the nearest hydrant. The only protection available was water from a small hand hose on standpipe system in mill.

S-10947. Cotton Mill. The fire was first noticed breaking out of the carriage next to the head stock of mule spinner. Employees immediately

used the two lines of hose nearby, but on account of their location they were not long enough to reach the seat of fire, but they were effective in preventing the fire from extending through the entire mule carriage. Fire was extinguished by four sprinklers, chemical extinguishers, and one large hose stream from standpipe in tower.

Interior hose protection should be arranged. and sufficient hose supplied, to cover all portions of mill.

S-10937. Cotton Mill. Fire started from foreign substance in stock on the rolls of the garnet picker. Two small hose streams, pails of water and chemical extinguishers were used which, with the sprinkler which opened in the hopper, extinguished fire in about five minutes. The stock on the machine and in hopper of picker nearby was destroyed, and the stock on the floor ignited, but the private fire protection equipment extinguished fire without loss.

S-11001. Cotton Mill. Fire occurred in cotton mill, being extinguished by automatic sprinklers and hose streams.

About nine o'clock, fire being practically under control, the two large hose streams were shut off, probably simultaneously, and it is supposed that this raised the pressure at the rotary pump, which caused the relief valve to open. This relief valve had been piped off to tailrace to take care of escaping water, but for some reason this pipe had been disconnected, and when the valve opened the water flew mainly toward the main belt and card room belt, which are only a short distance from the pump. The water caused these two large belts to come apart and slip off the pulleys. The load being suddenly taken off, the low pressure engine raced and presently the fly wheel burst, tearing out the end and part of the roof of the engine room, damaging one engine, tearing away the big counter in the basement of the mill, destroying a portion of the first floor of the mill over the counter and considerably damaging that end of the property. The high pressure engine was not, however, materially injured. The supply pipe to the sprinklers was torn down, and from that time there was no pressure on the system.

The waste pipe from relief valve should be of sufficient size to care for all water that may be discharged through same. It should be attached to the discharge cone below relief valve by flange connections, so that valve and cone may be readily removed for repairs without disturbing the waste pipe.

S-11231. Cotton Mill. Fire occurred in a cyclone dryer from unknown cause. Employee opened dry room door preparatory to putting a truck of yarn into dry room, when he discovered that truck of yarn already in dry room was afire. He drew out the blazing truck and gave the fire alarm. Other employees nearby immediately moved all yarn away from the fire and used the fire pails which were on a bench near the dryer, partially extinguishing the flames. In addition to fire pails, eight sprinklers opened and fire was completely extinguished in about five minutes. In the

meantime the electric power had been turned off plant and the hose laid, but it was not necessary to use it and no public alarm was given.

Spread of Fire.

H-6320. Manufacture of Monuments and Building Marble. Fire was discovered under the driving wheel in engine room. Engineer gave fire alarm by blowing the whistle, and as throttle was on opposite side of belt from whistle cord the flames were too hot to allow his shutting off steam after he had given the alarm. The governors failed to work when the belt burned and broke, and the driving wheel exploded, breaking two steam pipes from boilers and allowing the steam pressure of both boilers to exhaust onto the flames. As engine room was in line with the plant the fire had a clean sweep, spreading over the entire shop, the exhaust from the two steam pipes fanning the flames. Loss $175,000.

Frame buildings of large area should be divided into several fire sections by standard fire walls. Fire walls should be of brick not less than twelve inches thick and should be parapetted at least three feet above roof projecting to cut off overhang in roof, if any. Fire wall should also extend at least five feet at sides, or if it is not feasible to extend wall, a T-wall can be constructed with five feet wing walls on each side of fire wall.

Openings through fire wall should be as few as possible and should be protected by approved automatic fire doors installed on each side of wall.

H-6393. Furniture Factory. Fire started, or was first discovered, about the steam coils which were used to heat the detached dry kiln and the mill building proper. Coils were located on the first floor of mill building and were encased in a metal box raised from the floor, exhaust steam being used for heating. The cause of fire is unknown. It seems hardly probable that fire could have started in the dry kiln and spread against the forced draught to fan house, although there was a strong wind in that direction at the time of the fire. It is more probable that fire started in or near the fan and was blown through heating ducts throughout the mill and to dry kiln.

The mill building was of large area without fire walls dividing same into restricted fire areas, and was filled with kiln dried lumber in process of manufacture.

In less than an hour after fire was discovered the walls of building collapsed, the kiln dried material, assisted by the strong wind blowing at the time, spreading fire with great rapidity and fierceness. The dry kiln, mill building, boiler house and dust house were totally destroyed. Loss, $62,350.

H-6937. Laundry. Fire occurred in a one-story and basement brick building divided into two fire areas by a substantial brick wall. Fire occurred in the section occupied as a laundry, but was prevented from spreading into the candy store by the brick fire wall.

Standard Rules and Requirements

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Wired Glass and Metal Window Frame Construction	1906
Underwriters' Laboratories, general information in reference to the nature of its work and the terms and conditions under which tests of fire appliances and materials are conducted	June, 1911

NOTE: **Special lists** of Fire Appliances, Devices and Materials, examined and tested by Underwriters' Laboratories, Inc., under the above standards and deemed suitable for use, are mailed to members semi-annually in January and July.